Create more value and give more function to tailor made pigments, fillers and flame retardants.

Evonik additives meet your demands with focusing on high value end applications like

- Functional fillers for automotive compounds
- Special MDH and ATH grades for HFFR compounds
- Increase filler loading for heat conductive compounds
- Easy to disperse pigments for plastic colorizing
- Avoid pigment bleeding

**TEGOMER® DA 640 (30% active)**
- 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 646 (100% active)**
- Dispersing of organic pigments/carbon black in water-based slurries and organic solvents
- Strong viscosity drop
- High color strength development for organic pigments/carbon black

**TEGOMER® DA 850 (40% active)**
- Excellent rheological properties even after long-term storage of pigment paste
- Reduces particle size in precipitation steps and improves color strength
- Less water uptake than polyacrylic acids or polyphosphates
- Prevents settlement of high density fillers/pigments

**TEGOPREN® 6875 (100% active)**
- Alkyl modified siloxane to be used for surface treatment of inorganic fillers and all kind of pigments in plastic formulations
- Easy to handle and easy to implement into the production process

**TEGOPREN® 6875-45 (45% emulsion)**
- Bi-functional siloxane with high surface interaction
- Results in super-hydrophobic surfaces
- Also usable for carbonates and sulfates

**TEGOPREN® 6879 (100% active)**
- Hydrophobic, non-ionic polyether siloxane based wetting and dispersing agent
- It is a highly efficient dispersing agent, especially recommended for fine or nano scaled fillers, such as organo clays

**TEGOPREN® 6879-50 (50% emulsion)**
- Hydrophobic surface improves the weatherability and water repellence
- Less fiber breaks and reduced FPV for pigments in masterbatches for fibres and films
- Improved UL 94, reduced burning time, CTI increase and enhancement of LOI for flame retardants
- Improves mechanical and surface properties of plastic parts

**BENEFITS**
The use of Evonik’s organo modified siloxane technology (OMS) and polymeric organic dispersants offers several advantages:

- No VOC and no migration
- Faster filtration in water-based production processes, which saves drying time and energy
- Less agglomeration of pigment or filler, even in dry stage
- Easy dispersing with higher filling levels in a variety of polymers
- Less specs and higher color strength in finished plastic parts
- Hydrophobic surface improves the weatherability and water repellence
- Less fiber breaks and reduced FPV for pigments in masterbatches for fibres and films
- Improved UL 94, reduced burning time, CTI increase and enhancement of LOI for flame retardants
- Improves mechanical and surface properties of plastic parts
TEGOMER® DA GRADES AS DISPERSANTS AND FLOCCULANTS FOR WET MILLING AND PRECIPITATION PROCESSES

TEGOMER® dispersants and flocculant
Due to their special chemical nature TEGOMER® DA additives:

- 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 polyolefin and technical polymers
- Reduce the viscosity of the slurry enabling higher loadings during wet grinding stage

TEGOMER® DA in Pigment Manufacturing Processes
- 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

Filter cake with high water content
+ H₂O + TEGOMER®
Filter cake turned liquid with TEGOMER® to remove additional water – Less drying capacity needed
- H₂O
Filter cake with low water content
High retention of pigment without discoloration (fine pigment particles) in cycled water

TEGOMER® DA
Dispersing agent with polar + organophilic groups
Aggregate
Hydrophilic Groups
Polymeric Backbone
Organophilic Groups

Control
with TEGOMER® DA 850
with TEGOMER® DA 640
TEGOMER® DA for filler production by wet milling
Wet milled CaCO₃ slurries used for paper coating with high gloss

- **Left bottle:**
  No dispersant used, coarse particles result in settlement

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

- **Right bottle:**
  Dispersant used but still settlement and coarser particle

TEGOMER® DA for wet milled MDH
Using TEGOMER® DA 850 results in significant viscosity reduction enabling wet milling or a MDH filter cake with 55% solid content.

TEGOPREN® 6875/TEGOPREN® 6875-45 and TEGOPREN® 6879/TEGOPREN® 6879-50 for the post-treatment of titanium dioxide
During the production of TiO₂ our additives can be added either in the TiO₂ slurry (wet stage) or during milling (dry stage), illustrated in the processing picture right. It can be added during the regular production. Therefore, no extra investment is needed. TEGOPREN® an inert OMS based liquid, which allow easy handling.

TEGOPREN® grades allow the same hydrophobization as silicone oils but does not create disadvantages in the final application, like VOC or migration which results in fish eyes, sealing or printing issues or loss of mechanical properties. Furthermore, a higher bulk density and better storage properties on pallets can be achieved with OMS technology. On the right side is illustrated as a simple test to visualize the effect of the surface treatment: TEGOPREN® grades hydrophobize the oxidic surface so effectively that even the high density material as TiO₂ floats on water.

Uncoated TiO₂
hydrophilic

TiO₂ untreated, dry material from burner or calcination (oven)

Inorganic Treatment in water SiO₂, Al₂O₃ or ZrO₂

Addition of TEGOPREN® 6875-45 or TEGOPREN® 6875

Filtration

Filter cake

Drying

Addition of TEGOPREN® 6875 with steam

Milling e.g. steam milling

TiO₂ pigment (inorganic and organic treated)

TEGOPREN® 6875 treated TiO₂ hydrophobic, swims on water
TEGOPREN® 6875/TEGOPREN® 6875-45 and TEGOPREN® 6879/TEGOPREN® 6879-50 for the post treatment of organic pigments

Not only inorganic pigments but also organic pigments can be treated by TEGOPREN® grades and are turned from a hydrophilic character to a hydrophobic pigment. Furthermore, this pigment is more compatible to the polymer matrix, what is essential especially for masterbatch applications.

TEGOPREN® 6875/TEGOPREN® 6875-45 and TEGOPREN® 6879/TEGOPREN® 6879-50 for filler treatment

Most fillers are produced by wet or dry milling. In both cases our additives can be applied quite easily at the end of the milling stage, in the tumbler or filtration step. The treatment will give better storage behavior in the silo. The filler is more compact, less dusty and has a reduced tendency of bridging and baking, which allows homogenous and therefore faster feeding in the compounding step and results in fewer variations of filler content.

SOME EXAMPLES

Treatment of ATH or MDH for HFFR compounds

The use of treated fillers in the production of cable compounds shows outstanding advantages:

- Improved dispersion of fillers
- Better hydrophobic properties
- Smooth and supple cable surfaces
- No influence on printability
- Better flame-retardant properties in the UL 94V and Cone Calorimeter measurement (reduced HRR: see heat release graph on the right side)
- Increased LOI values
- Significant char formation

<table>
<thead>
<tr>
<th>HRR [kW/m²]</th>
<th>0</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
<th>350</th>
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</thead>
<tbody>
<tr>
<td>ATH without Additive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>ATH with 1% TEGOPREN® treatment</td>
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</tbody>
</table>
Treatment of organic flame retardants, e.g. APP for polyolefin-based flame retardant compounds

Treating an APP with TEGOPREN® for using it as flame retardant in a PP-based compound results in a better flame retardant properties on a constant level of FR content. A heat treatment over 1h at 110°C can further improve the performance and V-0 can even be reached at lower levels of FR content while total burning time (TBT) is even reduced.

<table>
<thead>
<tr>
<th>additive</th>
<th>FR [%]</th>
<th>UL94V 1.5mm</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>class</td>
</tr>
<tr>
<td>reference</td>
<td>30.0</td>
<td>V-2</td>
</tr>
<tr>
<td></td>
<td>27.5</td>
<td>V-2</td>
</tr>
<tr>
<td>1.0% TEGOPREN® 6879</td>
<td>30.0</td>
<td>V-0</td>
</tr>
<tr>
<td>1.0% TEGOPREN® 6879 (1h @110°C)</td>
<td>27.5</td>
<td>V-0</td>
</tr>
</tbody>
</table>

Treated fillers in the production of automotive compounds

TEGOPREN® 6875 treatment will optimize the processing, which will lead to an extended tool life and reduced energy consumption. In this example the MFI could be increased more than 50% and 15% electricity has been saved.

<table>
<thead>
<tr>
<th>Deviation [%]</th>
<th>Amperage Draw</th>
<th>Pressure</th>
<th>MFI</th>
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<tbody>
<tr>
<td>1.0%</td>
<td>-10</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>2.0% (surf. treatment)</td>
<td>-20</td>
<td>-20</td>
<td>30</td>
</tr>
</tbody>
</table>

Effect of talc treatment in TPO application

- No reduction of stiffness
- Better effect on impact resistance (notched charpy)
- Important reduction of CLTE (Coefficient of Linear Thermal Expansion)
- Reduced scratch visibility (Erichsen on grained surfaces K09 and K31)
- Improved hydrophobicity
- Better dispersion and distribution of the talc
Method of surface treatment
Mixing Equipment in Pilot Plant at Evonik Essen

Three Henschel Mixer with different volume for surface treatment trials exist in the Pilot plant. The Henschel mixer allow to mix fluffy pigments, fillers and flame retardants with small amounts of viscous OMS additives. The high shear force guarantees a proper coating of the complete surface in a dry stage operation.

Improved/Increased Bulk Density
Advantages due to surface treatment of pigments, fillers and flame retardants:

- Increased bulk density
- Less dusty appearance
- No bridging in the feeder
- More robust processing

Reduced Lacing
Advantages due to surface treatment of pigments, fillers and flame retardants:

- Higher loading possible
- Better dispersion
- No specks
- No lacing
- Higher color strength/better hiding power
Comparison of different technologies for the surface modification of pigments and fillers

<table>
<thead>
<tr>
<th>TEGOPREN® 6875</th>
<th>TEGOPREN® 6875-45</th>
<th>TEGOPREN® 6879</th>
<th>TEGOPREN® 6879-50</th>
<th>Silicone oil</th>
<th>Silanes</th>
<th>Stearates</th>
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<tbody>
<tr>
<td>Handling in production</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Hydrophilization</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>EC/FDA</td>
<td>-/+</td>
<td>+/+</td>
<td>+/+</td>
<td>+/+</td>
<td>-</td>
<td>+/+</td>
</tr>
<tr>
<td>Influence on end application (migration, sealing, printing)</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Loading [%]</td>
<td>0.2 – 2.0</td>
<td>0.2 – 2.0</td>
<td>0.4 – 2.0</td>
<td>0.4 – 1.0</td>
<td>0.2 – 1.5</td>
<td></td>
</tr>
</tbody>
</table>

+ = positive influence  ∘ = moderate or no influence  - = negative impact

PICTURES OF DIFFERENT FILLERS

- Titanium dioxide
- Calcium carbonate grinded
- Aluminium silicate
### Recommendation for the Surface treatment of Fillers, Pigments and FR

<table>
<thead>
<tr>
<th>Type</th>
<th>EVA</th>
<th>PP</th>
<th>PA</th>
<th>PBT</th>
<th>PC</th>
<th>Epoxy</th>
<th>UPES</th>
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<td>TiO₂</td>
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<td>TP 6875</td>
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<td>CaCo₃</td>
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<td>Al₂O₃</td>
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<td>Clay</td>
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<td>MDH</td>
<td>TP 6875</td>
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