Dispersing Agents for the Digital Revolution in Printing Inks

TEGO® Dispers 750 W and TEGO® Dispers 752 W are the Front Runners for Aqueous Inks

TEGO® Dispers products have historically proven themselves in numerous coating and printing ink formulations. However, new and challenging applications are constantly being presented, and the products must be able to satisfy the latest demands. Of these, the use of digital printing across a variety of substrates – especially textiles and ceramic tiles – has come into focus and taken priority within the inks industry.

Editorial

Dear Readers,

Sustainability is a topic that is impacting the world. Handling existing resources in a conserving and at the same time efficient way for the benefit of future generations is a key factor in Evonik’s business activities. With our power to innovate and our conviction, we strive to help make the world of tomorrow a little more sustainable. This is why we offer our customers products and system solutions that with little effort help to considerably reduce the consumption of energy and resources.

Whether it’s durable road markings, marine coatings that reduce fuel consumption, or media-compatible packaging, our products often only make up a small proportion of the end product. They nevertheless often have a decisive impact on the properties of the end product, and despite their small material input represent major added value for our customers and for the environment.

A good example is the global lowering of emission limits for volatile organic compounds (VOCs), which is resulting in the demand for lower-VOC coating technologies. Find out about the solutions we offer for this in the latest issue of "The Coatings Expert."

We hope you enjoy reading the new journal!

Yours,

Dr. Claus Rettig
Chairman of the Board of Management
Evonik Resource Efficiency GmbH
A new era in the printing inks sector

Over the past 30 years, the printing inks sector has been revolutionized by the meteoric development of digital inkjet printing\(^1\). From office printers to printed textiles and awnings to mobile phone shells, inkjet technology has come to provide unlimited design possibilities across a multitude of printing platforms. Because of this, previously stagnant sectors are experiencing an upturn and are showing increased sales as a result.

One of the main reasons for the upward trend in digital printing is the printing process itself. With speeds of up to 75 m/min, digital printing has become as efficient as conventional processes. Additionally, because it doesn’t require direct contact with a substrate, the digital process allows for printing on relief surfaces and possibly even 3D structures.

The second contributing factors are the printed images themselves. By applying picoliter sized ink droplets (pl corresponds to \(10^{-9}\) ml) through the more than 100 nozzles, sized a few micrometers, on a print head in a microsecond timeframe, images can be created on desired objects that have a resolution of over 1000 dots per inch (dpi). This order of magnitude is such that the individual dots cannot be perceived by the eye but can still create a visually flawless image.

Meeting raw material needs

A byproduct of the benefits provided by digital printing is the change in demands on the raw materials utilized for this application. For example, the dyes used for printing on fabrics must be finely ground down to the nanometer size range. This not only prevents the appearance of defects that can occur when the print head nozzles become clogged, but more importantly, it allows for the stringent demands on color intensity and brilliance to be met. Viscosity of the dyes also plays an important role in this application. Because shear rates of up to 500,000 sec\(^{-1}\) can occur during the process, high shear resistance, Newtonian flow, and viscosity less than 10 mPas are essential to ensuring optimum jetability. In comparison, digital printing on ceramic tiles requires the application of a larger amount of material, so particle sizes need only reach the low micron range, and viscosity can be extended to a maximum of 25 mPas. Regardless of application, TEGO® Dispers, Foamex, and Humectant materials help meet the demands of various digital printing inks.

Best practice for textile digital ink

TEGO® Dispers 750 W was tested against a standard additive using the textile inkjet formulations shown in Table 1. The formulations with the standard dyes Yellow 54, Brown 27, and Blue 360 were dispersed for 4 hours in an LAU Disperser with three parts by weight glass beads Ø = 1–1.2 mm; glass beads Ø = 2.5–2.8 mm were used for Pigment Red 122. These dispersions were then sieved and assessed after sitting under ambient conditions for 24 hours. If you’d like to further optimize the formulation to a finer particle size, then we would recommend dispersing with 0.3–0.4 mm zirconium beads using a bead mill. However, our experience shows that the LAU Disperser screening gives results which are comparable to those obtained when utilizing a bead mill.

<table>
<thead>
<tr>
<th>Table 1: Formulations for textile ink concentrates based on dyes and pigment</th>
</tr>
</thead>
<tbody>
<tr>
<td>raw material</td>
</tr>
<tr>
<td>dye</td>
</tr>
<tr>
<td>water</td>
</tr>
<tr>
<td>Yellow 54</td>
</tr>
<tr>
<td>Brown 27</td>
</tr>
<tr>
<td>Blue 360</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

**Table 1:** Formulations

**Figure 1:** Viscosities determined according to DIN EN ISO 3219 using Anton Paar Model NCR 301, geometry CPSO/2 at 23°C and a shear ramp of 1 – 1000 1/sec.
The assessment of these finished systems focused on the core properties of viscosity, particle size, and stability, both initially and after 2 weeks of storage at 50 °C. Figures 1 and 2 show the superior performance of TEGO® Dispers 750 W by highlighting that its use resulted in the lowest printable viscosities and the finest particle sizes when formulating with all the dyes and Pigment Red 122. In comparison, use of the standard additive resulted in an increase in viscosity and particle size initially and after storage testing across all formulations (especially in the case of dye Brown 27 where irreversible flocculates and a hard sediment formed after 2 weeks of storage – please see also figure 2). Because of its poor performance, the standard additive is not a suitable material for use in printing.

The poor performance observed when using the standard additive can be attributed to its insufficient anchoring and weak stabilization on the surface of the dye. This impaired storage stability may lead to undesirable viscosities and a rise in particle size via agglomeration. For this reason, modern dispersing additives are designed to be multifunctional. Their effectiveness is strongly influenced by their viscosity and a rise in particle size via agglomeration.

For this reason, modern dispersing additives are designed to be multifunctional. Their effectiveness is strongly influenced by their viscosity and a rise in particle size via agglomeration. For this reason, modern dispersing additives are designed to be multifunctional. Their effectiveness is strongly influenced by their viscosity and a rise in particle size via agglomeration.

It is important to note that the stabilization mechanism seen with TEGO® Dispers 750 W helps to obtain the lowest viscosities while maintaining outstanding shear and storage stability. For the ceramic waterborne sector, TEGO® Dispers 752 W helps overcome formulation challenges by exhibiting excellent viscosity reduction. Also, showing maximum stability by remaining homogeneous throughout the aging process highlights the benefit to using TEGO® Dispers 752 W in this application.

For guiding formulations and further information about digital printing inks and new applications, please contact us.


Text: Dr. Christian Maus and Birgit Flock

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Figure 2: 2 KEYENCE VHX 5000 digital microscopic images of textile ink concentrate with Brown 27 after one day storage at room temperature. Left: fine, homogenous particles with TEGO® Dispers 750 W (\(\eta_s = 294\) mPas). Right: coarse agglomerates with standard additive (\(\eta_s = 547\) mPas).

Figure 3: Schematic representation of the anchoring of a graft copolymer on a colorant surface.

Figure 4: Storage samples after 3 weeks at 50 °C of ceramic inks based on PB 28 with 43 % solids content. Left: no settling with TEGO® Dispers 752 W (\(\eta = 21\) mPas at 1000 1/sec.), Right: sediment with standard additive (\(\eta = 26\) mPas at 1000 1/sec.).

Best practice for ceramic inks

Close cooperation between manufacturers of printing equipment, inks, and tiles has resulted in digital printing almost completely replacing the customary rotary screen printing process in the tile market. The challenge of formulating high solids ceramic inks and glazes with hard-to-disperse, high-density particles for use in this market can be solved with TEGO® Dispers products. To illustrate this, waterborne ceramic inks were tested for the desired core properties of low viscosity and a low tendency for settling during an accelerated aging cycle. Figure 4 shows that sedimentation occurred with the standard product despite its raised viscosity, while TEGO® Dispers 752 W is highly effective and shows an impressively low viscosity. Furthermore, the ceramic ink remained homogeneous and stable with no formation of sediment after 3 weeks storage at 30 °C. Therefore, TEGO® Dispers 752 W makes printable, processable waterborne ceramic printing inks a reality.

Summary

TEGO® Dispers 750 W enables the high demands and new developments of digital textile inks to be met. Through special polymer design, this dispersing additive promotes strong anchoring of the dyes and pigments commonly used in the textile industry. Also, the pronounced electrosteric stabilization mechanism seen with TEGO® Dispers 750 W helps to obtain the lowest viscosities while maintaining outstanding shear and storage stability. For the ceramic waterborne sector, TEGO® Dispers 752 W helps overcome formulation challenges by exhibiting excellent viscosity reduction. Also, showing maximum stability by remaining homogeneous throughout the aging process highlights the benefit to using TEGO® Dispers 752 W in this application.

For guiding formulations and further information about digital printing inks and new applications, please contact us.

The requirements placed on packaging coatings are high because packaging substrates can vary widely. Yoghurt lids, for example, consist of aluminum or plastics like PET; these in turn must be sealed to a variety of container materials such as polypropylene (PP), polystyrene (PS) and polyethylene terephthalate (PET).

Evonik launched recently DEGALAN® VP 4311 E especially designed for paper / metallized PET structures to be sealed versus polystyrene (PS) or poly lactid acid (PLA). The product fulfills the market requirements of being PVC-free and easy to process by a single coating step.

In addition, DEGALAN® VP 4311 E already meets the requirements for contact transparency on flexible PET packaging.

Currently research at Evonik is dedicated to design a hybrid polymer structure giving access to fully transparent DEGALAN® heat seal binders. The major task for the development of this innovative product is to deliver a transparent heat seal coating on PET films. Of course the benefits of secure sealing and smooth peeling will be comparable to the existing DEGALAN® portfolio. The new product will simplify the formulation of heat seal coatings for transparent PET films enormously.

This new DEGALAN® grade will seal versus several cup materials like PS, PET, PVC and PVDC. The heat seal strength is supposed to reach more than 6 N/15 mm. Highlight for the new DEGALAN® grade is the improvement in transparency. Target settings require a haze below 10 of the corresponding heat seal coating (measured on PET film with a heat seal coating weight of 5.0 gsm).

Product launch of the new DEGALAN® grade will be in the first half of 2016.

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Protecting the Spirit

Evonik’s product group Pre-Coated Metal has developed two novel polyesters for the formulation of solvent borne packaging coatings with feasibility for alcoholic filling goods.

Perfecting the established DYNAPOL® product range to the needs of our customers is our commitment. The aim is to create special binder resins for high-quality paints serving packaging applications especially in fields of food, dairy as well as beer and beverage with its changing market needs.

Polyester VP 2010-38 is a medium molecular weight main binder delivered in solution. Coatings derived from this new product impart excellent flexibility and good media resistance. Thus, it is recommended for end uses with highly demanding forming processes, e.g. the production of roll on piller proof closures and twist-off- or crown caps from pre-coated metal sheet. As the final articles are mainly used for food and beverage packs it is important that the coatings are stable against the variety of filling goods. In lab tests coating films based on Polyester VP 2010-38 preserved their integrity after retort with aqueous and ethanoic food simulants.

New Polyester VP 4406 comes as solid granules allowing the paint formulator full freedom to formulate depending on the type of substrate, the application conditions and the end use. The latter may range from rigid metal packaging applications such as interior or exterior coatings for 2-piece and 3-piece cans to flexible packaging coatings where the polyester can be used in foil primers, heat-seal lacquers or overprint varnishes.

The base of both polyesters is in line with important regulation for food contact coatings including alcoholic foods.

Further information as well as product samples and paint start formulations are available on request for interested customers.

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It’s All about Coatings!

Did you already have a look at www.evonik.com/coatings?

The online presence provides a comprehensive overview of the company’s product and solution portfolio but also numerous additional information from the Coatings area. Product brochures, press releases, and publications are available in a download section. The Contact Finder helps you to easily find the right contact for technical and sales issues. See for yourself at www.evonik.com/coatings!
SILIKOTOP® – Innovative Binder Technology for High Solids Industrial Paints

Background and motivation

Solventborne paints have demonstrated over decades that they are easy to handle and are distinguished by a very wide processing window. The technology is reliable and established worldwide. However, since EC Directive 1999/13 came into force, many solventborne paints in European countries no longer meet the regulations for reducing organic volatiles.

Experience shows that, with conventional binder technology, it is not possible to formulate high solids paints with fewer than 250 g/l VOC. Simply reducing the solvent content in existing medium-solids paints to meet legal requirements results in a highly viscous paint which cannot be applied. To simply reduce the non-volatile components (NVC) in paints requires major changes in the molecular structure of the binder.

Reduction in molecular weight, improved solubility of the resin in common solvents, and lower intermolecular interaction are just some of the fundamental demands on innovative high solids binders. The challenge is to increase the NVC at working viscosity to comply with the regulations, without impairing drying (both touch and complete), optical appearance, or mechanical and chemical resistance.

One way of achieving high NVC at low processing viscosity is with 2-pack paints – in particular, isocyanate-curing silicone hybrid resins. Silicone hybrid resins combine a broad range of properties which result in high quality paints. The polyester component enables, for example, a high cross-linking density in the fully cured film which delivers very good mechanical and chemical characteristics. The silicone component in the resin molecule lowers viscosity. This effect is attributed to the free rotation of the silicone chains ~[Si(CH₃)₂ – O – Si(CH₃)₂]~ and their low tendency to interact. The silicone component also reduces the UV-yellowing tendency of the polymer.

Figure 1 compares SILIKOTOP® E 900 and SILIKOTOP® E 901 with a high solids polyester resin. It is obvious that the new type of silicone hybrid resins possesses a significantly higher NVC at comparable intrinsic viscosities of the polymer solutions.

At approximately 7500 mPas the conventional polyester resin solution has a NVC of 76%, whereas the new silicone hybrid resin has a NVC of 90%. This enormous difference gives the paint formulator great scope regarding other constituents in the formulation such as rheological additives or solvents.

Table 1: Test formulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SILIKOTOP® E 900</th>
<th>SILIKOTOP® E 901</th>
<th>High solids polyester</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVC of the ready to use paint DIN 4</td>
<td>84%</td>
<td>89%</td>
<td>73%</td>
</tr>
<tr>
<td>VOC in g/l of the ready to use paint</td>
<td>224</td>
<td>736</td>
<td>296</td>
</tr>
</tbody>
</table>

Test formulation

The properties of the aforementioned resins were compared using formulated 2-pack paints. Two variants of the new silicone hybrid resins were compared with a commercial high solids polyester:

SILIKOTOP® E 900: Silicone hybrid resin with more flexible segments
SILIKOTOP® E 901: Silicone hybrid resin with rigid segments
High solids polyester
SILIKOTOP® E 901 shows immediately – and particularly after a recovery of 24 hours – optimum resistance to the liquids mentioned above. This is attributable to the higher rigid segment content in the silicone hybrid.

SILIKOTOP® E 901 exhibits outstanding resistance to various liquids in tests carried out according to DIN EN ISO 2812-4 (see Table 4).

**Table 4: Resistance to liquids**

<table>
<thead>
<tr>
<th>Chemicals test</th>
<th>SILIKOTOP® E 901 after 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic oil</td>
<td>OK</td>
</tr>
<tr>
<td>Antifreeze</td>
<td>OK</td>
</tr>
<tr>
<td>Sulphuric acid (10%)</td>
<td>OK</td>
</tr>
<tr>
<td>Hydrochloric acid (10%)</td>
<td>OK</td>
</tr>
<tr>
<td>Pancrust (1:1 in deionized water)</td>
<td>OK</td>
</tr>
</tbody>
</table>

Salt spray test

The use of the new type of silicone hybrid results in paint films with a very high cross-linking density. This, together with skilful formulation of pigments and fillers in the paint is an important influence in withstanding the salt spray test. A 2-pack epoxy primer was applied to a sand-blasted steel substrate. The primer was then overcoated with a white top-coat based either on the new type of silicone hybrid resins or on conventional high solids polyester. The test was carried out in accordance with DIN EN ISO 12944 Category C3 I and M. The images show results after 1440 hours.

**Figure 2: Resistances to ÖNORM A 1605-12**

![Figure 2: Resistances to ÖNORM A 1605-12](image)

Salt spray test: Left: High solids polyester, Right: SILIKOTOP® E 900

Stone impact test

Resistance to stone impact was tested according to DIN EN ISO 20567 1. Metal panels were prepared by painting them with 2-pack epoxy primer and top coats based on SILIKOTOP® E 900 and SILIKOTOP® E 901, and high solids polyester. After a period of recovery the test was carried out on the coated sheet. The result shows clearly that SILIKOTOP® E 900 with its increased toughness and resiliency contributes to an improvement in the index for stone impact resistance.

**Figure 3: Result of salt spray test after 1440h**

Left: High solids polyester, Right: SILIKOTOP® E 900

**Figure 4: Left: conventional high solids polyester, Right: SILIKOTOP® E900**
**Pinhole limit**

To assess the working window of the resins, the paint was applied wedge-wise using a pneumatic spray apparatus. Here the favorable influence of the silicone unit in the polymer is particularly evident. Compared with the polyester, the silicone hybrid resin shows about 30% less pinhole formation in a comparable cured-coating thickness. Silicone hybrid resins permit trouble-free application of greater coating thicknesses.

**Top coat appearance**

The reduced tendency of silicone hybrid resins to form pinholes is especially beneficial for the optical appearance of the applied coating, again showing the positive effect of silicone in the paint.

**Measurement of contact angle**

Apart from when high-temperature resistant coatings are required, there are a number of reservations in the coatings industry concerning the use of silicone raw materials. As SILIKOTOP® E 900 and SILIKOTOP® E 901 are also well suited for formulating primers, contact angles of the cured coatings were measured. The higher the contact angle, the more difficult it is to wet the surface with a subsequently applied coating layer.

### Table 6: Contact angle measured immediately and after 3 min.

<table>
<thead>
<tr>
<th>Exposure time</th>
<th>SILIKOTOP® E 900</th>
<th>SILIKOTOP® E 901</th>
<th>High solids polyester</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 s</td>
<td>78 °</td>
<td>82 °</td>
<td>82 °</td>
</tr>
<tr>
<td>180 s</td>
<td>75 °</td>
<td>79 °</td>
<td>74 °</td>
</tr>
</tbody>
</table>

It can be seen that the silicone does not affect the wettability; hence, the use of silicone hybrid resins in primers does not lead to any problems.

**Cross hatch adhesion test**

Silicone units in the polymer do not affect adhesion. Primers were formulated with silicone hybrid resins, applied and subsequently overcoated with conventional top coats. Additionally, coatings formulated with silicone hybrid resins were overcoated using the same paint. Adhesion tests, carried out to DIN EN ISO 20567, gave a characteristic value of GT 0-1 in all cases, as with comparable binders.
Overview

<table>
<thead>
<tr>
<th></th>
<th>SILIKOTOP® E 900</th>
<th>SILIKOTOP® E 901</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids content (in butyl acetate)</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>OH number relative to solids</td>
<td>~6 %</td>
<td>~6 %</td>
</tr>
<tr>
<td>OH number relative to solids [mgKOH/g]</td>
<td>~200</td>
<td>~200</td>
</tr>
<tr>
<td>Acid number relative to solids [mgKOH/g]</td>
<td>&lt; 9</td>
<td>&lt; 9</td>
</tr>
<tr>
<td>Viscosity 25°C [Pa s]</td>
<td>~9</td>
<td>~7</td>
</tr>
</tbody>
</table>

Stone impact resistance  
Flexibility (Falling sphere impact test [indirect])  
Flexibility (ERICHSEN cupping)  
Drying time (drying recorder)  
Degree of curing  
Chemical resistance  
Pendulum hardness (KÖNIG)  
Weathering resistance  
VOC content (ready for use)  

*= recommended  
**= well recommended  
***= especially recommended

Impact strength

The impact strength of SILIKOTOP® E 900 and SILIKOTOP® E 901 is clearly shown in the impact test to DIN EN ISO 6272-1/2. Fig. 9 shows the results of a 1 kg weight falling from a height of 1 m on to the coated specimen. The upper deformation is the result of the reverse impact test.

This property of SILIKOTOP® E 900 and SILIKOTOP® E 901 leads to good deformability and adhesion of the coating on different substrates.

Figure 9: Impact test; Left: SILIKOTOP® E 900, Centre: SILIKOTOP® E 901, Right: high solids polyester

Compatibility

The compatibility of silicone hybrid resins in current binders is also very good and well balanced.

Table 7: Compatibility

<table>
<thead>
<tr>
<th></th>
<th>SILIKOTOP® E 900</th>
<th>SILIKOTOP® E 901</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount added relative to binder</td>
<td>70 %</td>
<td>50 %</td>
</tr>
<tr>
<td>High solids polyester resin, 85% in butyl acetate</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>Branched polyester, 65 % in methoxypropyl acetate</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>Low-molecular polyester, 70% in solvent naphtha 100/xylene</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>High-solids acrylate resin, 85% in butyl acetate</td>
<td>OK</td>
<td>OK</td>
</tr>
</tbody>
</table>

Pigmentability

It should be noted that silicone hybrid resins have very good pigment wetting properties both in tinting with pigment pastes and in direct grinding with mixed pigmentation. This property promotes the corrosion resistance of the formulations. However, wetting and dispersing additives are necessary to formulate high-gloss paints with the lowest haze. In artificial weathering to ISO 4892-2 both silicone hybrid resins show color change ∆E < 1.0 after 6000 hours which permits good long-term color stability of the paint.

Summary

SILIKOTOP® E 900 and SILIKOTOP® E 901 are particularly suitable in top coat applications for corrosion protection covering a range of uses from transportation to marine applications. Coats up to 200 µm can be applied in one step. Their combination of good adhesion and flexibility makes them suitable for coating plastics and for coil coatings.

In addition to excellent corrosion protection, minimal tendency to yellowing and weathering, chemical- and mechanical resistance, SILIKOTOP® E 900 and SILIKOTOP® E 901 offer exceptional benefits in processability and optical appearance. With silicone hybrid resins having a non-volatile content of 90 % and concurrent low intrinsic viscosity, formulation of paints with extremely low VOC content (200 – 100 g/l) is possible. Additionally, the silicone hybrid resins enable simple handling during manufacture and application of the paints making these materials user-friendly. Primers, top coats and direct-to-metal (DTM) paints can all be formulated with silicone hybrid resins.

Contact

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ACEMATT® – These coatings are gaining special purpose matting agent, due to high loading of matting agent typically needed. The result can be achieved. Maintaining good clarity, transparency and an optimized surface treatment, a proper matting providing a particle size corresponding to the film thickness coatings with minimal film shrinkage. The difficulty to matte high film thickness coatings with minimal film shrinkage is its dependency on packing density so the overall volume shrinkage influences the matting effect.

### 100 % Solids UV Coatings

Due to the lack of evaporating components such as water or solvents, this coatings segment presents its own unique challenges to achieve low gloss finishes. By using the right oligomers, monomers and photo-initiators and by modifying all accessible process parameters such as temperature, line speed and curing conditions, the volume shrinkage can be enhanced (Please find more detailed information in the brochure "Matting solvent-free UV-curing coatings" on www.acematt.com). Together with a matting agent providing a particle size corresponding to the film thickness and an optimized surface treatment, a proper matting result can be achieved. Maintaining good clarity, transparency, and useable viscosity are all challenging due to the high loading of matting agent typically needed.

**Our recommendations:**
- ACEMAT® TS 100 – all-purpose, highly efficient matting agent, particularly suitable for water-based coatings, waterborne UV coatings. Optimum performance with regard to transparency, therefore widely used in clear coats and leather coatings. Providing high chemical resistance.
- ACEMAT® 3300 – special purpose, highly efficient matting agent with organic surface treatment, particularly suitable for water-based coatings, waterborne UV clear coatings, leather coatings & soft-feel coatings. Optimum performance with regard to additive adsorption and in-can-stability. Providing high chemical resistance.
- ACEMAT® OK 520 – all purpose, highly efficient matting agent with organic surface treatment, particularly suitable for water-based coatings, waterborne UV coatings. Providing high transparency and chemical resistance.

### High Solids Coatings

The matting effect is created by a matrix of silica particles, formed during drying within the coating layer and finally structuring the surface of the film. With reduced amount of volatile components such as water or solvents, the formation of the named matrix becomes difficult. As there are various systems of high solids coatings on the market, the selection of the right matting agent is crucial.

**Our recommendations:**
- ACEMAT® 3600 – special purpose matting agent, providing very low thickening effect, excellent clarity and high chemical resistance.
- ACEMAT® HK 400, OK 500 or OK 607 – all-purpose, fine grained matting agents, best suited for low VOC decorative paints.
- ACEMAT® 3300 – special purpose matting agent, providing best drying performance due to minimized drier absorption.

### Waterborne Coatings

Increased momentum in the market place is focused on converting to waterborne technology to meet stringent VOC demands and increase environmentally acceptable solutions. Typical challenges regarding gloss reduction in waterborne coatings are maintaining high clarity, in-can stability as well as keeping proper rheology (Please find more detailed information in the brochure "ACEMATT® for water-based Furniture and Parquet Coatings" on www.acematt.com). Waterborne coatings also tend to be lower in viscosity and require matting agents that disperse easily in low shear environments. The ACEMAT® product line offers several matting agents well suited for waterborne coatings. Thermal silica with or without surface treatment show the best overall results while precipitated silica provide good efficiency and value.

**Our recommendations:**
- ACEMAT® OK 520 – all purpose, highly efficient matting agent, particularly suitable for water-based coatings, waterborne UV coatings. Optimum performance with regard to transparency, therefore widely used in clear coats and leather coatings. Providing high chemical resistance.
- ACEMAT® 3300 – special purpose, highly efficient matting agent with organic surface treatment, particularly suitable for water-based coatings, waterborne UV clear coatings, leather coatings & soft-feel coatings. Optimum performance with regard to additive adsorption and in-can-stability. Providing high chemical resistance.

### Long Oil Alkyd, Air-Drying Decorative Paints

Due to new VOC guidelines many coating producers have to work on their formulations in this field. The use of metal containing catalyst used to dry and cure these systems creates challenges as iron- or manganese-based driers tend to be absorbed by silica based matting agents.

**Our recommendations:**
- ACEMAT® HK 400, OK 500 or OK 607 – all-purpose, fine grained matting agents, best suited for low VOC decorative paints.
DEGAROUTE® Anti-Blackening Markings

On behalf of Dubai’s Road & Transport Authority (RTA), Evonik tested a new system of DEGAROUTE® based cold plastic MMA road markings to reduce the problem of fading safety markings in arid areas such as Dubai in the United Arab Emirates.

The UAE have one of the most progressive transportation infrastructures in the entire Middle East region. Dust and dirt often lead to serious problems: After a relatively short time, road markings are too dirty to be visible which threatens road safety.

Evonik’s Road Marking team has worked on a solution to beat the dirt on Arab road markings. The proposed solution was a special system based on DEGAROUTE® cold plastic that is hardened by the chemical reaction of two materials. It then receives a thin layer of a vanish-type material as protection.

In selected areas in Dubai, the new system and traditional thermoplastic markings were tested and compared with each other. Less than 12 hours after both materials had been laid, the remarkable difference in appearance between the products was obvious: While the DEGALAN® PM 602 has obtained approval for use in curing and sealing membranes on fresh concrete. Coatings based on DEGALAN® PM 602 have been tested by an independent laboratory in Tampa, Fl. and certified to comply with Type 1 requirements of ASTM C 309 (Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete) and Type 1, class A requirements of ASTM C 1315 (Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete). It is possible to apply such a cure & seal coating within the first 24 hours of casting fresh concrete. The applied sealer based on DEGALAN® PM 602 allows for the controlled evaporation of water from green concrete and gives a pleasant appearance after drying. Cure & seal coatings based on DEGALAN® PM 602 also offer the added benefit of being non-yellowing. Therefore, an additional application of an extra concrete sealer may not be necessary. The application of a cure & seal coating helps to save on material and labor costs.

Evonik offers DEGALAN® PM 602 in addition to DEGALAN® LP 64/12, a pure acrylic resin, which is approved for diverse concrete coating applications, such as the use in concrete sealers on fully cured concrete. A sealer based on DEGALAN® LP 64/12 offers a pleasant wet look effect and protects the concrete from ambient influences.

The DEGALAN® PM 602 is only available in Asia-Pacific, USA and Canada.

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SURFACE MODIFICATION
These systems cure at ambient temperature, using a catalyst in the presence of atmospheric moisture, thus economizing on the energy needed for baking. The size of the parts to be coated is not limited by the size of the oven, thus opening up further fields of application, particularly in industry. The smoke formation, which occurs with traditional bake-cure silicone resins, and the VOC content are markedly reduced thus meeting the continuously increasing targets for more eco-friendly coatings systems.

The benefits of SILIKOPHEN® AC 950:

- Coating of large objects is easily possible
- Improved early water resistance
- End properties of the coating are obtained with ambient curing
- No hazardous substances emitted
- Permanent temperature resistance up to 600°C
- Low smoke formation on exposure to high temperatures

Silicone resins offer numerous advantages in high-temperature applications compared with classic bake-cure systems. The three innovative SILIKOPHEN® AC products are compared in the table on the right side:

High-Temperature Resistant Coatings: New Fields of Application Thanks to SILIKOPHEN® AC 950

The commercial success of silicone resins in the field of high-temperature resistant coatings is based on their special properties. Alongside the classic bake-cure systems, ambient curing systems are enjoying greater success.

<table>
<thead>
<tr>
<th>SILIKOPHEN® AC products</th>
<th>SILIKOPHEN® AC 900</th>
<th>SILIKOPHEN® AC 950</th>
<th>SILIKOPHEN® AC 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity [mPas]</td>
<td>130</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>Solvent content</td>
<td>10%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Functional [% w/w]</td>
<td>15-20% / Methoxy</td>
<td>18-25% / Ethoxy</td>
<td>30-40% / Methoxy</td>
</tr>
<tr>
<td>Addition of TEGO® KAT 1 or TEGO® KAT 1 and TEGO® KAT 2 [ratio 1:1 or 1:2, relative to solid silicone resin]</td>
<td>1-3% TEGO® KAT 1</td>
<td>0.5-5% TEGO® KAT 1 / TEGO® KAT 2 = 1:1</td>
<td>3-6% TEGO® KAT 1 / TEGO® KAT 2 = 1:2</td>
</tr>
<tr>
<td>Pigment wetting</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
<tr>
<td>Flexibility during heating/adhesion on rolled steel</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
<tr>
<td>Surface drying/Drying at room temperature</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
<tr>
<td>Temperature resistance 400-600°C</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
<tr>
<td>Color stability &lt; 400°C</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
<tr>
<td>Color stability &gt; 400°C</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
<tr>
<td>Xylene resistance (after RT drying)</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
<td>⬤⬤⬤⬤</td>
</tr>
</tbody>
</table>

* = recommended ⬤⬤⬤⬤ = well recommended ⬤⬤⬤⬤⬤ = especially recommended

**Contact**

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DYNAPOL® Terra: Bio-Based Binder Systems for Coil-Coated Metals

Resource efficiency is a key growth driver of the future.

For years, consumers and government agencies have challenged the raw materials industry as well as the coatings and paint industry in its downstream value chain to reduce the environmental impact of their products and processes. The use of renewable, bio-based raw materials for coating binders represents an important way to achieve this objective. The demand for and market establishment of bio-based products is steadily on the rise due to increasing awareness of sustainable action and long-term price increases for fossil and finite resources.

Architectural applications in exterior and interior end uses tend to give preference to sustainable, certified coating systems with recognized environmental labels, for example on sheet metal.

Pre-coated sheet metal or metal strips have been the material of choice for interior and exterior architectural applications for decades. Steel and aluminum substrates, which are continuously pre-coated in the so-called coil coating process, are used in large quantities for roof and wall cladding, ceiling panels, household appliances and air-conditioning units as well as in numerous other applications. In addition, the food and beverage industry relies on pre-coated sheet metal such as TFS (tin-free steel) or aluminum for two- or three-piece cans.

Conventional coil coating lacquers are typically based on saturated, hydroxy-functional polyester polyols as main binders, which are produced mainly from petroleum-based raw materials. Although bio-based replacements from sustainable sources are known for many of these petrochemical components, they are often not available in adequate qualities or at an industrial scale.

The research and applied technology unit of the Pre-Coated Metal Product Line in the Coating & Adhesive Resins Business Line of Evonik Resource Efficiency GmbH identified bio-based components suitable for polymer synthesis that were available for industrial-scale production. After extensive development work, the company launched DYNAPOL® Terra, a new polyester resin product family.
TEGO® Dispers 678 satisfies the requirements of industrial paint manufacturers because it:
- achieves low ∆E values, thus leading to stable colors
- exhibits good results in the condensation-water test, thus proving it is ideally suited for use in mechanically and chemically resistant paints
- lowers the viscosity of the millbase, thus permitting significantly greater non-volatile content
- produces good results in terms of gloss and leveling after application thus achieving a superior appearance
- possesses outstanding storage stability which increases process security
- is optimally suited for use in medium solids coatings and, therefore, reduces the number of raw materials used in the manufacture of coatings.

TEGO® Dispers 678 is a general purpose product which complements the existing TEGO® Dispers range of specialty products for high solids and medium solids coatings.

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Finding a property profile that matched the characteristics of common polyester resins (DYNAPOL® LH types) was one of the biggest challenges. Coil coatings made with DYNAPOL® Terra have excellent crosslinking properties. Baked coatings also show a balanced ratio of hardness and flexibility along with excellent flow properties, good process stability and remarkably high weather resistance, as tested in accelerated QUV weathering tests and outdoor exposure tests performed in Florida.

The sustainable resource use associated with the production of DYNAPOL® Terra polyester resins has been tested, confirmed and certified by DIN CERTCO, a German company for conformity evaluation (Bio-based Product Certification Program (2014-01) on the basis of ASTM D 6865:2012-01).

Users of the new DYNAPOL® product family can now certify their downstream products and have a solid basis to obtain regulatory approvals or meet specifications regarding the proof of environmental compatibilities. DYNAPOL® Terra polyester resins are suitable for coil coating primers, top coat and backside coatings and offer excellent opportunities for innovative coating formulators to set themselves apart from the competition.

In addition to expanding its DYNAPOL® Terra product portfolio of sustainable binder resins for coil coating applications, Evonik Resource Efficiency GmbH is also working on bio-based polyester resins for can coating applications.

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Reg.-No. 8C059
Reg.-No. 8C060

SUSTAINABILITY
In the paints and coatings industry, AEROSIL® primarily serves as a tool for adjusting rheology during production, storage, and application. AEROSIL® allows to optimize the dispersion characteristics and stability of the pigments used, as well as the flow properties and thickness of applied films. It also enhances the resistance and barrier effect of the dried, cured finish – an especially important property for protective coatings.

As water condensation and salt spray tests show, already adding hydrophilic AEROSIL® makes coating films stronger and more compact – an effect that is magnified significantly through the use of hydrophobic AEROSIL®. Treated coatings exhibit less of a tendency to swell, which, in turn, minimizes corrosion creep and peeling.

AEROSIL® R 972: Surface modified with dimethylsilyl groups; universal additive for protective coatings of all kinds.

AEROSIL® R 812: Surface modified with trimethylsilyl groups; particularly recommended for 2K-PUR systems.

AEROSIL® R 805: Surface modified with octylsilyl groups; particularly recommended for 2K epoxy systems.

AEROSIL® R 202/R 208: Hydrophobized with polydimethylsiloxane; particularly recommended for marine and other applications requiring exceptional corrosion protection. These products contain free silicone oil.

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AEROSIL® Supports Corrosion Prevention/Protection

Using fumed silicas to improve cured coatings

Optimized hydrophobized silicas for a number of different applications:
AEROXIDE® Alu: Flow Aid and More

Ideal for storing, transporting, and dispensing powder coatings, and for controlling their charge

In response to the ongoing trend towards environmentally safe coating systems, the market for powder coatings is growing at a significantly faster rate than that of conventional liquid coatings. Silica-based flow aids are added to powder coatings so that the latter can be handled without complications such as clumping, bridge formation, or differences in coating thicknesses.

Whereas AEROSIL® harnesses the ball-bearing effect to enhance the flowability of powder coating particles, the AEROXIDE® Alu product line takes it a step further:

AEROXIDE® Alu C: This finely grained, pyrogenic aluminum oxide provides a high specific surface area. This additive can also be given an electropositive charge, which is an essential property for triboelectric application.

AEROXIDE® Alu 130: An even finer fraction is available for optimizing flowability. Other properties related to electrostatic charge capacity remain fully intact.

AEROXIDE® Alu 805: Here, the finely grained, pyrogenic aluminum oxide has also been treated with octylsilane. Hydrophobizing powder coatings in this way helps them to resist moisture—a major advantage in tropical and subtropical climates.

Because they can all be used with the corona application process as well, AEROXIDE® Alu products serve as universal powder coating flow aids.

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TEGO® Dispers 747 W – A Novel Dispersing Additive for Inorganic Pigments

Color strength and hiding power have long been desired properties in the architectural coatings market where improved performance is required.

The use of pigment concentrates in this application provides a modern and flexible way to produce tinted paints. Usually, pigment concentrates—based on the huge class of iron oxides—are formulated with polyacrylate salts as dispersing additives. Unfortunately, this older technology limits performance in terms of coloristic properties and long-term stability of the pigment concentrates.

A newly developed class of dispersing additive, TEGO® Dispers 747 W, combines the advantages of electrostatic stabilization and steric stabilization. This combination leads to long-term pigment stabilization and consistent high-color strength, even after long-term storage.

TEGO® Dispers 747 W offers outstanding viscosity reduction in pigment concentrates which enables the manufacturer to achieve higher pigment loading. TEGO® Dispers 747 W improves efficiency by its ability to increase pigment loading at lower workable viscosities. It also reduces complexity due to its ability to bind and stabilize nearly all inorganic pigments with one dispersant. TEGO® Dispers 747 W can be used for the preparation of waterborne pigment concentrates, as well as for the direct grind of inorganic pigments for architectural coatings.

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TEGO Web Seminars: Up-To-Date and Effective

Interactive, easy to understand and always topical: Comprehensive know-how on additives and resins for coatings formulations is just a few clicks away.

The TEGO Web Seminars have been conveniently accessible for customers all over the world since 2012, providing information on eco-friendly and energy-efficient system solutions from Evonik for the coatings industry.

To sum up the customer benefits of the TEGO Web Seminars, Susanne Struck, Vice President Global Applied Technology, explained, "Our Web Seminars are far more than just product launches. They combine background knowledge and information on the latest developments in a succinct, easy to understand form. Participants quickly acquire basic knowledge on additives and special resins and are given early information about new products. Your technical contact is at hand to help you put the ideas into practice in your laboratory. It couldn’t be easier."

Customer access to TEGO Web Seminars is very easy: After a one-time registration on www.tego.de, users can obtain the log-in data required for every Webinar at the simple press of a button. Video recordings of the presentations and direct contact with experts provide access for customers who could not be there live. "Our short Webinars enable us to efficiently train and inform our customers," said Christina Hirsch, Senior Manager Technical Training responsible for Web Seminars at TEGO. "The focus is always on technical content and direct interaction with participants." TEGO Web Seminars currently take place once a month in English with one morning session and one afternoon session (German time) to serve most time zones. Other languages are planned for the seminars, with the Chinese language being next.

Customers seem to agree. The number of registered users of the Web Seminar Platform and of active participants per seminar continues to grow. See for yourself under the tab “seminars” at www.tego.de!

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Dates
April 12 – 14, 2016
American Coatings Show | USA, Indianapolis
November 30 – December 2, 2016
ChinaCoat | China, Guangzhou
April 4 – 6, 2017
European Coatings Show | Germany, Nuremberg

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