Keep the Pack Stainless! – New DYNAPOL® Polyesters for Interior Can Coating Solutions with Excellent Protective Properties

DYNAPOL® polyester resins serve versatile coating solutions for metal packaging containers. Evonik is driving the extension of the DYNAPOL® series for food contact applications. Two new high molecular weight polyesters – DYNAPOL® L 907 and L 914 – are leading to coatings with excellent media resistance. Sterilization tests with respectively coated metal cups were carried out in the presence of spicy and colored foodstuff. These harsh test conditions simulated the retort process in food can filling lines. The test metal cups were perfectly protected.

DYNAPOL® polyester resins are well established high quality paint binders for pre-coating flat metal sheet or strip which is subsequently formed and finally used in diverse end applications – one of them being metal packaging containers or simply “cans”. The DYNAPOL® product portfolio offers a versatile range of saturated, middle and high molecular weight polyester resins suitable for can coatings matching the technical needs of the market. Additionally, many DYNAPOL® grades are in compliance with common regulatory frameworks for food contact applications. This is important because when it comes to protective interior coatings for food cans such health & safety aspects influence the acceptance and approval by authorities and throughout the whole value chain. Given this fact, paint
manufacturers and raw material suppliers place more emphasis on coating systems that are more environmentally friendly and less harmful to health. The high demand for low-odor, low-VOC (volatile organic compounds) coatings in public areas such as hospitals, airports, and public transportation systems is driving the development of new coating technologies.

Two new high molecular weight polyesters – DYNAPOL® L 907 and L 914 – from Evonik are presenting appropriate alternatives to the paint manufacturing industry. Both products are main binder resins and designed for interior, high performance BPA-non intent (BPA-NI) can coatings. DYNAPOL® L 907 has a high glass transition temperature of 75°C while offering a high degree of coating film flexibility at the same time. During the can manufacturing process perfect film flexibility is inalienable necessary due to deep-drawing and bending processes of the pre-coated metal sheets. In addition, coatings derived from L 907 convince by high resistance towards sterilization conditions as required in real food can filling lines.

During the development of DYNAPOL® L 914 focus was on further improvement of sterilization resistance, by increasing the glass transition temperature to 100°C, more durable coating films are achievable. Despite this high glass transition temperature there is hardly any trade-off in flexibility. Some experiments and results based on the two new products are described in the following.

To simulate the sterilization process taking place in a real can filling line in a laboratory, the coated cans were sterilized in presence of food-types which are commonly packed in metal cans. Tomato paste and hot peppers were chosen as sterilization media, representing strongly colored, salted and spicy aggressive filling goods. Gold and white colored DYNAPOL® L 907 and L 914 based coatings are challenged by these media and compared to an epoxy based gold-lacquer for reference.

The pictures illustrate the pre-coated and formed test cans after the sterilization process. In more detail, Figure 1 shows the specimen after sterilization at 129°C for 30 minutes in “Chiles Jalapenos”, a type of hot peppers. It can clearly be seen that both test cans remain untouched after the sterilization process. The coatings maintained their initial gloss, did not absorb the food colorants and did furthermore not indicate any adhesion loss; not even at the intensely bent edges and corners. When comparing these findings with the test results received from a standard epoxy-gold lacquer (Figure 2), it can be clearly seen that this epoxy coating suffers from limited film flexibility and adhesion to the metal substrate. For that reason the coating film peels-off the can. In consequence, the foodstuff would no longer be protected from the metal substrate of the can and vice versa.

Usually white pigmented coatings are more sensitive for discoloration by natural food colorants when compared to above mentioned gold-lacquers. Figure 3 shows the formed test cans after the sterilization process in sieved tomato paste for 30 minutes at 129°C. Tomato paste is a very aggressive foodstuff because of its strong red color and acidic pH value. Obviously both coating films have passed the sterilization process without changing their whitish sheen or absorbing the red dyes. Besides that, the coatings are completely undamaged and do not show any indication of adhesion loss.

The test results speak for themselves and confirm the strong performance of the new DYNAPOL® grades. In the crucial points, film flexibility, adhesion and resistance towards sterilization conditions, DYNAPOL® L 907 and L 914 are outstanding.

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DEGADUR® 4U – Next Generation Flooring Resins

Today, occupational safety, environmental friendliness and the acceptance of chemical materials are more in public focus than ever before. This development has also affected the construction chemistry over the last years and led to several shifts in the landscape of industrial flooring applications. Isoximate-free systems are becoming increasingly interesting for sensitive application areas such as hospitals, airports, train stations, supermarkets, car parks, etc. where public traffic may be affected by high foot traffic. The new resin system still features the beneficial properties of the (meth)acrylate chemistry, such as rapid curing, UV-stability and a remarkable durability. In addition, the new resin system comes with no flammability and contains partially bio-based components, also reducing the carbon footprint. Hence, the new DEGADUR® 4U resin family combines the advantages of MMA systems with reduced odor, improved handling properties during installation, reduced safety measures on the job site and green aspects. The DEGADUR® 4U product family represents an attractive addition to Evonik’s existing DEGADUR® portfolio.

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New Granulate Solution for Flexible Packaging Coatings: DYNAPOL® L 323

Evonik has added the new DYNAPOL® L 323 to its product range. Customer sampling and product marketing can begin immediately.

DYNAPOL® L 323 is an amorphous, high-molecular copolyester that was specially developed for use in the manufacture of flexible packaging. What makes the new product stand out is its excellent adhesion to different qualities of PET and aluminum foil in particular. This was achieved by setting a relatively low glass transition temperature of 30 °C, which makes the polyester highly flexible at the same time. Such amorphous polyesters with a low glass transition temperature normally tend to interlock on account of their surface tack. This means they can only be handled in solution, melted down in barrels or packed in panel form in release foil. Whereas delivery in solution gives customers less freedom in the coating formulation owing to the fact that the solution is defined from the outset, working with solidified melt in barrels or in panel form is very cumbersome for customers.

From the very beginning, the aim was therefore to create the new polyester as a granulate in spite of its low glass transition temperature. This reduces transportation and storage costs, makes it easier for customers to handle, and enables them to decide individually on the solvents. Thanks to the special formulation and elaborated process management, Evonik succeeded in averting the risk of interlocking at a low glass transition temperature. DYNAPOL® L 323 is permanently protected against this and easy to process, which offers customers enormous benefits and also makes their work easier.

The new DYNAPOL® L 323 complies with the required regulations for coatings that come into contact with food (EU, FDA) and is thus suitable for use in modern, flexible food packaging.

Products from the DYNAPOL® L family are tried and tested in the manufacture of flexible packaging. They are used wherever good adhesion to polar substrates with flexibility is required. They are primarily used as binders in primers, overprint varnishes, and hot-seal coatings. They can also be used as co-binders in printing inks or as an interlayer in the manufacture of multilayer foils.

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Hot Stuff – DEGALAN®
Heat Seal Binder from Evonik

Food packaging must be securely sealed and keep the product fresh. At the same time, it must be quick and easy to open. That means the lid of a yogurt cup must be sealed firmly enough to keep the yogurt well protected, but should still be easily removable from the cup. Lids are coated with heat seal lacquers and sealed onto the cup to keep this connection clean and secure. With DEGALAN® brand methacrylate-based binders, Evonik offers the ideal solution for formulating these heat seal lacquers.

Functional polymers on the basis of methacrylate chemicals, which Evonik sells under the brand name DEGALAN®, are an essential component of heat seal lacquers. These methacrylate binders possess excellent properties for formulating heat seal lacquers and offer a wide range of possibilities for sealing yogurt packages. Aside from yogurt cups, DEGALAN® products also ensure a particularly strong seal in blister packs for pharmaceuticals.
Heat seal coatings formulated with a DEGALAN® organic dispersion can be universally used for sealing any cup. That means every DEGALAN® organic dispersion forms a seal with all conventional cup materials, such as polystyrene (PS), polyethylene terephthalate (PET), or vinyl (PVC) with varying parameters such as sealing temperature or manufacturing technology. Of course, the material may not represent any health or environmental risks.

Evonik offers four different groups of DEGALAN® binders. These include 100% solids, so-called bead polymers, organic solutions and dispersions, as well as aqueous dispersions. The great bandwidth of the portfolio allows for formulating a large variety of heat seal lacquers for sealing most commonly used cup/lid combinations.

Heat seal coatings based on DEGALAN® are best used for sealing when a. PVC-based adhesion promoters are often needed in addition to the heat seal binder for coating aluminum lids. These are either applied in advance as an additional primer or directly included in the formulation of the heat seal lacquer. Polyesters also are generally used as a primer for lid materials made of PET. DEGALAN® VP 4174 E by Evonik is an organic dispersion that allows for direct adhesion on both PET and AL lids. The product eliminates the need for the previously required PVC-based adhesion promoters, making DEGALAN® based heat seal coatings highly environmentally friendly. The elimination of adhesion promoters also reduces the complexity of production processes for lacquer formulators as well as film/foil converters, which has interesting cost benefits.

DEGALAN® heat seal binders meet the requirements of international foods regulations such as Commission Regulation (EU) No. 202/2014 and FDA 21 CFR § 175 for materials that are intended to come into contact with foods.

**Direct adhesion created with bead polymers**

Even though bead polymers are used for sealing yogurt cups, their most frequent application is found in blister packs for pharmaceuticals. Until now, manufacturers had to use a combination of PVC-based adhesion promoters and DEGALAN® P24 heat seal coatings for pharmaceutical blister packs. The new generation of heat seal-capable bead polymers developed by Evonik methacrylate experts therefore represents a major breakthrough.

The new product, DEGALAN® VP P 34, is dissolved, for example, in ethyl acetate and can then be applied directly to the aluminum foil. This eliminates the previously required priming or inclusion of PVC-based adhesion promoters in the formulation. DEGALAN® VP P 34 meets the requirements for adhesion on aluminum foil and for forming seals with blister packs in heat seal coating. At the same time, the fact that the new DEGALAN® VP P 34 replaces the two previously required binders reduces the complexity of the lacquer formulation. This reduction, in turn, has a positive effect on the use of the required solvents in the overall formulation. DEGALAN® VP P 34 is a bead polymerize that can easily be dissolved in ethyl acetate, a common, relatively cost-effective, highly volatile solvent for heat seal formulations. As long as the other formulation components are suitable for this solvent, the overall formulation can therefore be reduced to the use of a single solvent.
Excellent properties confirmed

DEGALAN® VP P 34 is characterized by its high heat seal strength on different substrates. The heat seal strength was tested* and documented in the applications technology laboratory. For this purpose, two comparable formulations were created. In one formulation, the binder DEGALAN® VP P 34 was dissolved in ethyl acetate. In the comparison formulation, DEGALAN® P 24 was dissolved in methyl ethyl ketone (MEK), together with a PVC copolymer. In the resulting stabilization eliminates any tendency for settling or phase separation of the particles. This behavior is maintained during curing so that all the ALBIDUR® particles are statistically distributed during the liquid, uncured and fully cured stages (Figure 2). Because they are uniformly dispersed within the binder matrix, the elastomer particles ensure that the impact strength is isotropic. If subjected to external forces, the particles deform like a shock absorber. During this process, the external forces are largely absorbed by the elastomer particles and thus prevent fracturing in the coating.

The manufacturing process results in particle sizes with a D90 value of approx. 0.3µm. The particle sizes, the differing refractive indices of the silicone elastomer, and the differing refractive indices of the surrounding resin matrix result in the white color of the ALBIDUR® silicone elastomer core-shell particle dispersion.

These application technology studies illustrate that the new DEGALAN® VP P 34 is able to replace the previously used binder combinations of DEGALAN® P24 and PVC adhesion promoters in existing formulations. Due to the direct-adhesion properties of DEGALAN® VP P 34, no additional adhesion promoter is needed in the formulation, which leads to further simplification in formulating heat seal lacquer.

* according to DIN 55529, "Packaging: Determination of the seal seam strength of seals made from flexible packaging materials"

**Type: HSG-C, Brugger company

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ALBIDUR® – Tough But Flexible On Impact

The use of core-shell silicone elastomer particles results in a marked increase in the impact strength of coatings

Hard, highly crosslinked, mechanically-resistant coatings suffer from a serious disadvantage: They are not flexible on impact and are rather brittle with poor resistance to cracking. It subjected to a sudden impact, the coating is deformed, partially detached and spalls. The substrate is then unprotected, and its optical and essential usage criteria are unsatisfactory, necessitating replacement or repair of the damaged object.

ALBIDUR® – Technology

In order to significantly improve the impact strength of a coating, ductile segments should be incorporated in the highly crosslinked, brittle matrix without impairing the mechanical properties of the network, i.e. the resultant coatings should be tough and hard. The ALBIDUR® core-shell particle technology permits a combination of these rather contradictory properties. In a patented process, micro-scale silicone elastomer particles are permanently incorporated in-situ within a resin carrier. The distinctive feature is the two-phase nature of these core-shell particles. In the center is a silicone rubber core encased by a shell. The core promotes the tough resilient characteristics. No covalent linkage exists between the core and the shell, the latter is simply physically anchored to the former. As a result, there is no significant change in the glass transition temperature in the cured paint film. The shell’s functional groups are adapted to suit the binder matrix (Figure 1).

The resulting stabilization eliminates any tendency for settling or phase separation of the particles. This behavior is maintained during curing so that all the ALBIDUR® particles are statistically distributed during the liquid, uncured and fully cured stages (Figure 2). Because they are uniformly dispersed within the binder matrix, the elastomer particles ensure that the impact strength is isotropic. If subjected to external forces, the particles deform like a shock absorber. During this process, the external forces are largely absorbed by the elastomer particles and thus prevent fracturing in the coating.

The manufacturing process results in particle sizes with a D90 value of approx. 0.3µm. The particle sizes, the differing refractive indices of the silicone elastomer, and the differing refractive indices of the surrounding resin matrix result in the white color of the ALBIDUR® silicone elastomer core-shell particle dispersion.
Improved impact strength

Significant resistances were observed when using a combination of the ALBIDUR® product with a 2-pack epoxy resin formulation. Proof of the increased impact strength was obtained using, inter alia, the Falling Weight Impact test according to DIN EN ISO 6272–1. At a film thickness of approx. 60 μm, the critical drop height in the Reverse Impact test could be increased by 900% from 10 cm to 90 cm (Figure 3).

Improvements in properties were also observed in the Multi Impact Stone Chip test to DIN EN ISO 20367–1. The coating with ALBIDUR® was susceptible to markedly less spalling and cracking. The characteristic value of damage saw a reduction of 2 units. The hardness of the finish was not affected by the use of ALBIDUR® particles. No significant softening could be detected with the common concentrations of silicone elastomer particles. The relatively soft core of the ALBIDUR® particle is shielded by a shell from the surrounding paint matrix, and the polymer network is not negatively affected by the use of the particles.

Additional advantages when using ALBIDUR®

In tests, such as the Constant Climate Condensation Water test (DIN EN ISO 6270, 240h) and the Salt Spray test (DIN EN ISO 9227 NSS, 168h) the use of ALBIDUR® products also significantly improved certain characteristics, such as the corrosion resistance of coatings.

Even very low concentrations of the particles were shown to result in significant permanent reductions in the sliding resistance of cured coating surfaces (Figure 4).

Applications

ALBIDUR® products provide paints with improved impact strength and with higher resistance to atmospheric effects, thus providing better corrosion protection. The reduction in the sliding resistance of the paint surface is also a noteworthy characteristic which could be of interest for the internal coating of pipelines. Because this is a platform technology, it is possible to convert various binder resin systems – such as polyols, acrylates or epoxies – into ALBIDUR® products using customized silicone elastomer formulations. These can be used to modify the most diverse coatings systems (solventborne and waterborne). ALBIDUR® products are solvent-free and have a shelf life of 12 months at room temperature. Recommended concentrations for improved impact characteristics lie between 10 – 20% w/w for optimum performance. The products are extremely easy to handle. Because they are supplied in free-flowing form, they can be added by stirring in without using bead mills.

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Evonik has developed a new and versatile product family of crosslinkers for scratch resistant high performance coatings. This innovative technology platform combines the benefits of silane chemistry with the advantages of polyurethanes enabling outstanding scratch resistance while maintaining urethane properties in coatings.

3-Isocyanatopropyltrimethoxysilane (IPMS) is the core building block of the novel approach. It is responsible for a high freedom of design creating tailor-made binders and crosslinkers. The high compatibility of the ‘silane/urethane-hybrids’ offers nearly unlimited possibilities for formulating scratch resistant coatings.

The approach can be applied in both, one and two component coating formulations. It introduces also the concept of a non-isocyanate (NISO) technology exhibiting and even exceeding polyurethane performance.

The best of silane- and urethane chemistry combined in one approach

The new silane/urethane-hybrid crosslinkers, called VESTANAT® EP-M, are based on IPMS. IPMS can react with any kind of isocyanate reactive groups, preferably with hydroxyl groups of diols, polyols or oligomeric diols (backbone) to build an alkoxysilane functional urethane linked crosslinker/binder. The backbone primarily determines the properties of the crosslinker and moreover influences significantly the attributes of the resulting coating.

For instance the longer the backbone of the crosslinker the more it acts as a flexibilizer in the coating. In contrast a branched and short backbone will result in a higher hardness.

The benefit of using VESTANAT® EP-M crosslinkers is that the interior structure still contains urethane linkages, known from modern aliphatic polyurethane coatings. Their advantageous impact on the properties of the coating e.g. the generation of good environmental etch durability and excellent mechanical properties.

There are two different reaction routes the IPMS based crosslinkers can react. The first route involves a condensation beginning with atmospheric moisture reactions with the alkoxy groups, followed by two silanols condensing to form Si-O-Si linkages. The other crosslinking mechanism is a transesterification reaction with a polyl. These two types of reactions allow for different methods of coating technologies, both as a two-component (2K) coating formulating a crosslinker with a polyl, and a one-component (1K) moisture cure coating where the crosslinker is the sole component on the binder matrix and condenses with itself.
A toolbox for custom-designed solutions

The technology platform opens up a wide range of possibilities to formulate scratch resistant coatings for a manifold of substrates such as wood, plastic and metals and many more.

The temperature sensitivity of the substrate and the desired curing conditions determine the choice of crosslinker (Figure 1). The VESTANAT® EP-MF grades are suitable for ambient temperature curing whereas the VESTANAT® EP-M types can be used for curing temperatures starting at 80 °C up to 160 °C. Besides the standard hardeners another options are given on both sides of the temperature scale to adjust certain mechanical properties using specially designed flexibilizers, VESTANAT® EP-MF 202 and VESTANAT® EP-M 222.

But whatever silane/urethane-hybrid crosslinker you choose, they all assist to improve significantly the scratch resistance of coatings suitable for different substrates (table 1). In table 1 the loss of "gloss", a value which describes the scratch resistance, was tested with different coating systems employing a modified crockmeter test (wet abrasion). The test performed consists of a bar with an abrasive textile brushing the coated surface in a detergent solution 160 times with a test load of 19.2 N. The gloss of the coating is measured via a reflectometer before and after crockmeter test (setting 20° angle). The difference between initial gloss and gloss after scratch test is an indicator for the scratch resistance of the coating. The smaller the deviation the more scratch resistant is the coating. The incorporated inorganic silicon and a high crosslinking density in the coating resulting from the reaction of the alcoxy groups (O-CH$_3$) guarantees an extreme durability against abrasive media such as brushes, dust and sand. Due to the fact that the silicon is uniformly distributed in the coating matrix a permanent anti-scratch effect is permanent.

![Figure 1: VESTANAT® EP-M family: Characteristics of the technology platform](image)

<table>
<thead>
<tr>
<th>VESTANAT® EP-M Family</th>
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<tbody>
<tr>
<td><strong>Substrate</strong></td>
<td><strong>Gloss/loss of gloss (gloss units)</strong></td>
</tr>
<tr>
<td>Metal</td>
<td>79/20</td>
</tr>
<tr>
<td>Metal</td>
<td>80/3</td>
</tr>
<tr>
<td>Metal</td>
<td>85/4</td>
</tr>
<tr>
<td>Wood</td>
<td>78/2</td>
</tr>
<tr>
<td>Plastic</td>
<td>79/2</td>
</tr>
</tbody>
</table>

* after modified crockmeter test

Table 1: Scratch resistant, VESTANAT® EP-M based coatings applied on different substrates
Silane/urethane-hybrid crosslinkers: far beyond standard

Beyond standard substrates like PMMA (Polymethylmethacrylat) and ABS (Acrylnitril-Butadien-Styrol) which can be improved by VESTANAT® EP-M, other materials can benefit from this new product class as well. The technology can also be used for a multitude of other applications that take an advantage from extreme scratch resistance for aesthetic or functional reasons. For instance, first test results obtained from stone coatings for kitchen countertops or glass coatings equipped with VESTANAT® EP-M look promising.

All given examples and ideas underline the high level of applicability and versatility of this new technology approach and document our statement:


Abstract: The VESTANAT® EP-M range is a family of silane/urethane-hybrid crosslinkers designed to generate high performance scratch resistant coatings applicable on a variety of substrates. Specific modifications enable curing even at ambient temperature. These crosslinkers are used if highest technical performance is needed. NISO-coatings are possible to formulate which even exceed PUR performance.

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Figure 2
Scratch resistant high performance coatings
BPA-NI Coatings for Direct Food Contact

VESTANAT® B 1186 A faces the challenges of the packaging industry

Since August 2013, Evonik holds a food contact notification for VESTANAT® B 1186 A as approved by the U.S. Food and Drug Administration (FCN No. 1268). This option to formulate PUR-coatings even for food contact applications offers our customers a variety of new developmental approaches.

The combination with high molecular weight DYNAPOL® L-type polyester resins yields coatings showing excellent flexibility and outstanding media resistance. These coatings even withstand the hard conditions of common sterilization tests for direct food contact.

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Blocked Polyisocyanates: VESTANAT® EP-DS 1205 TF

The tin free crosslinker for high performance waterborne coatings.

Aqueous, one component polyurethane systems are employed in particular if highest technical performance is needed, e.g. glass- or dip coatings.

VESTANAT® EP-DS 1205 TF is a tin free oxime blocked waterborne crosslinker. The product is cosolvent free, as well as alkylphenol ethoxylate free (APEO free) and can be used to formulate aqueous heat-curing 1K PU systems. In combination with water diluted or -emulsified OH-terminated resins this crosslinker is in its element.

Due to the basis of the product, an IPDI-trimer, coatings with excellent yellowing resistance and weatherability are easy to achieve. The incorporated blocking agent ensures an attractive balance between reactivity and storage life.

VESTANAT® EP-DS 1205 TF is the tin- and GHS labeling free crosslinker to formulate high performance waterborne coatings.

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Modern and Decorative "Wrinkle Coatings" Based On DYNAPOL® Polyester Resins

Modern, high quality architectural top coat systems are not just characterized by high weathering resistance, durability and excellent mechanical properties. Attractive paint surface designs and structural effects are becoming more and more important, following the motto “optimum functionality combined with most decorative visual appearance”.

Besides typical textured paints based on DYNAPOL® polyester resins and VESTOSINT® polyamide or DEGALAN® polymethacrylate fine powders as texturizing additive, so called "wrinkle coat" systems are gaining higher interest by the end-users over the last years. Wrinkle coated steel and aluminium metal strips are predominantly used for roofing and wall claddings, due to their visually interesting decorative appearance they are also used for domestic appliance housings and construction work sheets.

Continuous customer requests were the reason to start the development work for DYNAPOL® based wrinkle coatings by the application technology team of the product group Pre-Coated Metal of Evonik. So far the priority objective of coil coating paint developments was the formulation of perfectly high gloss or matted surfaces (15 – 30 microns dry film thickness), free of any defects. Contrary to this, wrinkle effects are caused by specifically created microscopically small surface disruptions.

The desired wrinkle effect needs to be developed by skillful paint formulation. It was found that the right choice and amount of catalyst which is needed for the crosslinking reaction between the polyester and the melamine resp. polyisocyanate is playing an essential role. Various solvent combinations are also supporting different wrinkle structures (fine to rough). Numerous DYNAPOL® coil coating top coat wrinkle starting formulations (pigmented or clear) are available for interested customers.

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Colorful, Glossy, Low Viscosity and Long Shelf Life?
No Problem with TEGO® Dispers 678!

The use of the new TEGO® Dispers 678 in high-quality two-pack high solids paints achieves a stable low viscosity and constant color. It is widely applicable and limits the number of raw materials in coatings production because it also exhibits outstanding results in medium solids formulations.

Limitations of traditional wetting and dispersing additives in advanced coatings

The use of high solids formulation is a proven way of reducing VOC emissions and meeting European Directive 2004/42/EU. The changeover from medium solids to high solids paint formulations is easy for paint manufacturers and for users as the production and application equipment is the same. In contrast, the use of waterborne or radiation-curing alternatives generally involves major changes in equipment, raw materials, and application techniques. The resulting investment can be avoided by the use of high solids coatings. Because of its good cost/performance ratio, high solids technology has now become common practice.

Despite many similarities between medium and high solids technologies, there is a marked difference between them: At application viscosity, high solids paints possess a significantly higher non-volatile content. This frequently poses difficulties in application, with achieving higher gloss, with drying, and with the storage stability of the paints. All the raw materials used influence the rheology, but wetting and dispersing additives are of exceptional importance\(^1\). The correct choice of wetting and dispersing additive decisively affects the rheology of a high solids paint (Figure 1).

Adjusting the working viscosity of high gloss high solids paints containing organic pigments is particularly difficult. The desired color should not change during storage or during various methods of application and drying times.

Increasing demands on current paints to meet the EU directive

Raw materials must be chosen carefully to avoid undesirable phenomena such as pigment sedimentation, color shifts, or increased viscosity after storage. The diverse pigment and filler surfaces must be homogeneously wetted and stabilized, particularly in the case of direct grinding, which is used when batches exceed a certain customer-specified size. The ideal wetting and dispersing additive reduces the viscosity in the paint and prevents pigment sedimentation during storage. The wetting and dispersing additives which are well established in medium solids technology are still used frequently in high solids formulations. However, they no longer satisfy the increasingly stringent demands of modern high solids technology. Often, the reduction of viscosity in combination with sufficient color stability/pigment stabilization is inadequate in high solids paints. The new TEGO® Dispers 678, however, has been developed specifically to achieve stable, low viscosity and constant color, particularly in high-quality two-pack high solids coatings (Figure 2). Because it also achieves outstanding results in medium solids coatings, TEGO® Dispers 678 meets the coatings industry’s need for a widely-useable product that can limit the number of raw materials required in manufacturing.

Properties of TEGO® Dispers 678

- TEGO® Dispers 678 has been developed specifically for the direct grinding of mixed pigmented two-pack high solids coatings. The strong reduction in viscosity permits high pigment and filler loading. In the applied coatings, it generates a good topcoat finish and stable color while providing good gloss retention. Adhesion is not impaired after exposure to condensation. The outstanding storage stability of coatings manufactured with TEGO® Dispers 678 contributes to resource efficiency.

- The high molecular polymer (50% dissolved in methoxypropylacetate/dibasic ester) exhibits very broad compatibility both in high solids polyesters and acrylates as well as in medium solids grades of the aforementioned binders. The star-shaped polymer has a high density of pigment-affinic groups and stabilizes inorganic pigments, organic pigments, and carbon blacks with equal efficiency.

- All in all, TEGO® Dispers 678 is distinguished by very easy and uncrtical handling and storage in the paint manufacturing process. Even at \(-18°C\), TEGO® Dispers 678 is still clear and liquid.

Test schedule

With mixed pigmentation, the wetting and dispersing additive is confronted with the particular challenge of reducing the millbase viscosity, wetting widely different pigment surfaces, and subsequently providing lasting stabilization. Only by satisfying all three criteria can color shifts, floating, floating, and settling be avoided. It is known that organic pigments are stabilized by aromatic anchor groups, while carbon blacks are stabilized by amine structures in the wetting and dispersing additive\(^1\). With mixed pigmentation, a wetting and dispersing additive with a customized molecular structure with differing pigment-affinic groups is required because the different surfaces must be stabilized to the same degree. To identify this structure, a test formulation as shown below was used.

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**Table 1**

<table>
<thead>
<tr>
<th>Viscosity curves with various wetting and dispersing additives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear rate [mPa·s]</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>100</td>
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<tr>
<td>1200</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1600</td>
</tr>
</tbody>
</table>

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**Figure 1**
TEGO® Dispers 678 generates the lowest viscosities at various shear rates

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**Figure 2**
Rub-out, 12 min. after spray application, center: TEGO® Dispers 678

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Test formulation 2-pack PU HS

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Parts by weight in % w/w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td></td>
</tr>
<tr>
<td>Mill-base:</td>
<td></td>
</tr>
<tr>
<td>Acrylate (70% in butylacetate), e. g. SYNOCURE® 9293</td>
<td>36.0</td>
</tr>
<tr>
<td>TEGO® Dispers 678 (50% in methoxy pro-pylacetate / dibasic ester)</td>
<td>2.0</td>
</tr>
<tr>
<td>Carbon black</td>
<td>0.2</td>
</tr>
<tr>
<td>Phthalocyanine blue</td>
<td>0.4</td>
</tr>
<tr>
<td>Titanium dioxide</td>
<td>12.0</td>
</tr>
<tr>
<td>Barium sulfate</td>
<td>4.0</td>
</tr>
<tr>
<td>Acrylate (70% in butylacetate), e. g. SYNOCURE® 9293</td>
<td>13.4</td>
</tr>
<tr>
<td>Methoxypropylacetate</td>
<td>4.0</td>
</tr>
<tr>
<td>Let-down:</td>
<td></td>
</tr>
<tr>
<td>Polyester (80% in butylacetate), e. g. DESMOPHEN® 670</td>
<td>16.0</td>
</tr>
<tr>
<td>Butylacetate</td>
<td>3.4</td>
</tr>
<tr>
<td>Blend of aromatic hydrocarbons</td>
<td>3.4</td>
</tr>
<tr>
<td>Xylene</td>
<td>4.3</td>
</tr>
<tr>
<td>TEGO® Airex 990</td>
<td>0.3</td>
</tr>
<tr>
<td>TEGO® Flow 500</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

| Part B |                          |
| Add. of hardener: |                          |
| HDI trimmer (70% in butylacetate) | 28.0 |
| VOC in g/l (calculated) of usable coating | 518 |

The above mixed pigmentation was chosen because wetting and dispersing additives can be easily differentiated using this sensitive tint. The wetting and dispersing additive must wet equally the various types of surfaces in this formulation and adhere to them; otherwise settling, separation, or color differences would show up in the rub-out test. In Part A, the use of a polyester in combination with an acrylic resin was chosen to assess the necessary broad compatibility of the wetting and dispersing additive. In two-pack topcoats for plastics substrates it is usually necessary to improve the elastic properties by a polyester resin.

The adhesion and performance of the most promising structures were subsequently tested in a humidity chamber. The paints were applied to degreased R46 steel test panels. Prior to the condensation-water test to DIN EN ISO 6270-2, the painted test panels were exposed in a humidity chamber. After two weeks, the coatings were examined for swelling, blushing, and blistering. After 24 hours regeneration time, a further cross-hatch test was carried out. Gloss, leveling, settling, and effectiveness in traditional medium solids coatings were further criteria considered in the choice of structure for the new TEGO® Dispers 678.

Results

The properties of TEGO® Dispers 678 in two-pack high solids paints are shown below and compared with those of the market standard for medium solids technology.

<table>
<thead>
<tr>
<th>Property</th>
<th>Market Standard</th>
<th>TEGO® Dispers 678</th>
</tr>
</thead>
<tbody>
<tr>
<td>∆E coated / rubbed surface before aging</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>∆E coated / rubbed surface after aging (2 weeks, 50°C)</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Visual description of aged specimens (2 weeks, 50°C)</td>
<td>formation of 33% grayish supernatant, no sediment</td>
<td>formation of 5% slight whitish supernatant, no sediment</td>
</tr>
<tr>
<td>Cross-hatch ISO 2409 24h after condensation-water test</td>
<td>GT 1</td>
<td>GT 0</td>
</tr>
<tr>
<td>Degree of blistering to DIN 53209</td>
<td>m1 g1</td>
<td>m1 g0</td>
</tr>
<tr>
<td>Cross-hatch to ISO 2409 on steel</td>
<td>GT 1</td>
<td>GT 0</td>
</tr>
<tr>
<td>Optical appearance (leveling, gloss, body) after aging (2 weeks, 50°C)</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>Viscosity of the paint (Part A) prior to aging (mPas at shear rate 100 [1/sec])</td>
<td>371</td>
<td>367</td>
</tr>
<tr>
<td>Viscosity of the paint (Part A) after aging for 2 weeks at 50°C (mPas at shear rate 100 [1/sec])</td>
<td>370</td>
<td>384</td>
</tr>
</tbody>
</table>

Table 1

Test formulation

Table 2

Properties of TEGO® Dispers 678 in two-pack high solids paints
Conclusion

The use of TEGO® Dispers 678 as a wetting and dispersing additive for modern mixed pigment direct grind simplifies manufacture and application. Modern high solids paints can be formulated to comply with the EU Directive. TEGO® Dispers 678 satisfies the requirements of industrial paint manufacturers because it:

- achieves low ΔE 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
- has a very low inherent viscosity (even at –18 °C) and is, therefore, easy to handle during production
- is also optimally suited for use in medium solids coatings and, therefore, reduces the number of raw materials used in the manufacture of coatings.

To sum up, 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.

Fewer VOCs, Faster Drying: the New DEGALAN® P 628

In all applications, acrylic resins (polymers) are characterized by their excellent resistance to UV light, color fastness, good gloss retention, and chemical resistance. One particular challenge for the paints and coatings industry is reducing and avoiding harmful VOCs (volatile organic compounds) in paint formulations.

DEGALAN® P 628 is a high-solidity solution polymer for combining alkyd resins for metal coatings. It is a technical refinement of DEGALAN® P 627, which has been around for many years. The percentage of VOCs in the solution polymer has been substantially reduced, allowing Evonik to respond to its customers’ needs and increasingly invest in the development of sustainable products.

By adding 10–20% of the polymer to alkyd resins, the degree of hardening can be reached faster. The weathering properties of the alkyd resin can also be improved further through a combination of binders. Combining the polymer with alkyd resin in formulations with micaceous iron oxide makes DEGALAN® P 628 suitable for corrosion protection applications.

The new product can also be used as a co-binder in paint formulations to plasticize them for external use.

As the solution polymer is broadly compatible, there is a wide variety of possible combinations with other binders.

Contact
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Urbanism Creates Colorful and Safe Spaces in Mexico City

With a population of around 21 million inhabitants, Mexico City is the most populated city in the western hemisphere. The recent increase in bicycle use and car sharing programs has sparked the need for dedicated lanes and parking areas throughout the city.

A perfect opportunity to create more durable, secure parking and traffic areas using DEGAROUTE® based MMA (Methyl Methacrylate) road markings!

150 public spaces were transformed into "public pocket parks". These will not only provide security and promote neighborly coexistence but also beautify the streets. Prior to the application, Evonik worked closely with the contractor to develop various colors of DEGAROUTE® based area marking formulations for the unique design of those public areas. Starting with La Condesa and Polanco, the city authorities were pleased with the results of the application. Covering an area of 800 m² (8,611 ft²), the area markings were applied to the asphalt substrate at a thickness of 0,6 mm (25 mils), using automated spray equipment and templates to ensure a precise design. Due to the rapid application process and curing capabilities of the system based on DEGAROUTE®, each pedestrian area was completely passable within 45 minutes. The UV resistance and excellent adhesion of the newly applied area markings will ensure optimal color stability and durability for years to come.

Pleased by the results, the local authorities plan to continue with the project. According to the company responsible for the formulation and application, "DEGAROUTE® based MMA cold plastic area marking is an excellent choice for city design planners due to the quick application process and the versatility to formulate unique colors, creating visually pleasing, safe and functional designs with outstanding performance on both concrete and asphalt. This allows planners to complete the application of more public pocket parks in less time."

Contact
Marisa Cruz
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"Public Pocket Parks" designated for rental cars
[PHOTO © Victor Benitez]
Evonik Launches New Coatings Website

From now, Evonik provides news from the coatings area on its Internet page www.evonik.com / coatings. The new online presence provides a comprehensive overview of the company’s product and solution portfolio but also numerous additional information. 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. The new website is available in English: www.evonik.com / coatings

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The mobile Coatings & Adhesives App delivers a rich, interactive way for customers to view of the broad assortment of Evonik’s competencies for the coatings & adhesives industry. It enables Evonik customers’ access to all forms of product information, service support, dialogue network and useful tools – wherever they use it.

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Silicic Acid Esters from the Dynasylan® SILBOND® Brand Make First Appearance at the European Coatings Show

Last year Evonik added to its leading market position for silanes with the acquisition of Silbond Corp. in Weston (Michigan, USA), a supplier of silicic acid esters. Silicic acid esters under the Evonik brand for functional silanes are being presented at this year’s European Coatings Show as Dynasylan® SILBOND®.

As a special group of functional silanes, silicic acid esters are also used in coatings. The most important silicic acid ester for applications in the coatings industry is Dynasylan® SILBOND® 40 and binders based on this product. “Dynasylan® SILBOND® 40 is used in anti-corrosion coatings and in zinc-rich binders,” explains Dr. Björn Borup, marketing director in the Silanes Business Line of the Resource Efficiency Segment. “The particular benefits of zinc rich coatings formulated with binders based on Dynasylan® SILBOND® 40 are its good resistance to chemicals, weather and temperature, which make it especially interesting for ship coating formulators.” Dynasylan® is used in a large number of high-performance applications in coatings, the treatment of metals and the synthesis of resins. It is used to modify surfaces, as a monomer for the synthesis of resins, and for the adhesion of organic coatings on inorganic surfaces.

Dates

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European Coatings Show | Germany, Nuremberg

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