Time is Money

Universal Matting of Powder Coatings in the Shortest Possible Time

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Life moves quickly. Trends and customer requirements in industrial processes are changing in ever-shorter cycles. Particularly, contract coaters must be very flexible when responding to incoming customer requests. Even the production of powder coatings is subject to constant change and is under the powder coating OT course. All the common systems, colors, textures and gloss values need to be considered. The disadvantage is that not every coater has access to large storage facilities and that this stock instantly ceases to be liquid cash.

Alternatively, most powder coatings manufacturers have started to offer short delivery times. However, this method does not always guarantee that the required systems are in stock when demand. They may even still have to be manufactured. And this is getting even more difficult due to the fact that supply chains are currently being disrupted by raw material shortages.

Powder coatings are time consuming to produce, and it is nearly impossible to alter their visual appearance in the middle of a production process. Powder coatings are solid, and they must be produced entirely separately. This makes it a challenge for the manufacturer and for the coater to respond flexibly and in the shortest period of time on customer demands. Until now, the only option has been to keep any non-powder coatings as possible in stock with a wide variety of different properties.

This article will describe an alternative option: a very simple, quick and completely label-free solution to meet the demand for different gloss values. This solution is available to powder coatings manufacturers that also to the coater, directly on the line.

The novel additive BYK-3908 F allows all types of powder coatings to be matted flexibly and immediately (Figure 1). To do so, a homogeneous mixture simply needs to be created with the basecoat (post-blending principle). No extruder is therefore required for this work step. The mixing process can be carried out with a variety of devices such as a tumble mixer or any other suitable solid substance mixer.

FIGURE 1 Dosage depending gloss reduction in different binder systems. Gloss levels at 60° angle.

HAA = weather-resistant powder coating based on polyester resin and hydroxylalkylamide as hardener HY = hybrid powder coating for interior applications based on polyester resin and epoxy resin in the ratio 70:30 and 50:50

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The finished compound can be applied in the coating line or simply stored under normal conditions. The mixture remains flowable and will not cause reactions with the powder coat. Therefore it has no effect on storage stability.

The additive can be used without considering stoichiometric ratios because the matting takes place through a physical process rather than a chemical one. The matting characteristics are controlled exclusively the additive dosage quantity or actually linear ratio and regardless of the binder system chemistry.

Since the additive is label-free, there are no restrictions on application fields, and no special safety measures need to be taken. The regulatory status of the matted powder coatings does not change either.

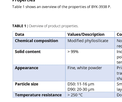
How is the Additive Incorporated Into the Powder Coating?

Usage is exclusively through post addition and mixing with the finished powder coating (Figure 2). Incorporation of the additive into the powder coating by extrusion only results in minimal gloss reduction and is therefore not recommended.

FIGURE 2 Schematic description of the post-addition of BYK-3908 F.

The additive does not require high shear forces to be mixed with the powder coating. However, the better and more thoroughly the incorporation is, the better the appearance of the resulting coating (Figure 3 shows a comparison of different mixing qualities at a dosage of 4%. Left: briefly by hand; mid: right, 5 minutes with a laboratory shaker. A significant improvement in surface quality can be achieved by better incorporation. The high homogeneity of the relative structure results from leveling properties.

FIGURE 3 Effect of incorporation quality on the visual properties of the coating.



Properties

Table 1 shows an overview of the properties of BYK-3908 F.

TABLE 1 Overview of product properties

Data	Values/Description	Comment
Chemical composition	Modified phyllosilicate	No hazardous content, no labeling required
Solid content	> 99%	Inorganic particles, no melting, no loss of weight upon high temperature (1,000 °C)
Appearance	Fine, white powder	Primary particles appear transparent, no effect on color shade or transparency
Particle size	D50: 11-16 µm D90: 20-30 µm	Particle size allows use in thin layer systems.
Temperature resistance	> 200 °C	Does not yellow

Matting Effect

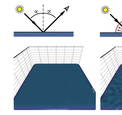
Theoretical Description of Gloss Reduction

Matting is a physical process that forms a rough surface in a targeted, almost parallel direction. This gives high reflection values, i.e. a high gloss.

As soon as light is diffused rather than reflected in a targeted manner, the surface appears matte. The surface must have a very fine texture to create the visual appearance of uniform matting. With a coarse surface structure, the eye may still perceive gloss areas and a sparkle effect may occur.

In figure 4, the lower photo shows the surface profile of a glossy powder coating in comparison to a powder coating matted with 5.0% BYK-3908 F. This illustration of 3D topography was measured and calculated with optical profilometer from BYK-Gardner GmbH. The measuring instrument takes several images illuminated from different angles and uses these to calculate the 3D topography. It is clearly evident that there is no microscopic present on the matted surface.

FIGURE 4 Illustration of the measuring principle: Direct reflection from a glossy surface (left) and diffuse reflection in all directions from a matte surface (right). The picture shows the measured 3D surface topography.



What is the Matting Effect of the Additive Based On?

The additive forms a very fine structure in the finished powder coating during the coalescence process. This structure is not visible to the naked eye. The matting process of liquids (or melts) on solid additive particles requires energy. This is the case when differences in surface tension during wetting process have to be compensated and when the melt generates into the pores (capillaries) of the agglomerates.

This matting process will not be completed because the continuing crosslinking reaction reduces the ability of the melted powder coating to flow. The additive particles are bound in the surface but do not sink completely into the powder coating. Particles have to be large cause a microtexture in powder coatings. Some particles also protrude from the surface and increase the effect of the diffuse light scattering.

This effect at the surface is comparable to the formation of a few texture by coarse filler particles in powder coatings. Unlike the BYK-3908 F, these coarse particles cause a microtexture and increase that particles into the interior of the wafer has evaporated.

In powder coatings with BYK-3908 F, the resulting microtexture is "fixed" by the crosslinking reaction and subsequent increase in viscosity. It can no longer flow smooth. The additive therefore has no direct effect on the chemical crosslinking, but its physical effect is to cause a light scattering diffusing surface.

For this reason, the effect is constant regardless of reactivity level or curing temperature. This allows the user to easily implement the desired level of matting. No adjustments are needed to the oven temperature or to dwell time. The curing parameters specified for the specific powder coating remain unchanged.

Application Examples

Which Powder Coating Systems Is This Additive Suitable For?

Gloss reduction can be achieved in all binder systems and with all formulations. Since the effect is independent of the chemical crosslinking reaction, it is independent of the binder system and of duroplastic network by chemical reaction. All binders are therefore virtually interchangeable, and next to the curing process. In this phase, the additive creates a microtexture that reduces the gloss (figure 5).

FIGURE 5 Example of a hybrid system and a β-HAA system that were matted using the additive.

The following binder systems are mainly used in the market:

- Polyester resins
- Epoxy resins
- Acrylic resins

Polyester coating systems offer a variety of combinations in order to meet the demands of all applications. Polyester resins containing carboxyl groups, crosslinked with β-HAA (β-Hydroxylalkylamide) or TGIC (triglycidylisocyanurate) are used for weather-resistant powder coatings.

Polyester resins containing hydroxyl groups with isocyanate crosslinkers have numerous applications in automotive industry. Pure epoxy resins and hybrid systems (polyester/epoxy) are primarily used for indoor applications.

Can the Additive be Used with Clearcoats?

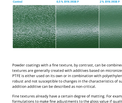
The primary purpose is to provide a high level of transparency due to the chemical composition as a modified phyllosilicate. For this reason, clearcoats can be matted very well with the additive. The microtexture on the surface causes diffuse light reflection. This light scattering is transparency of the additive particles does not affect the visual properties of the coating. Particles that are not fully embedded in the surface do not protrude and do not cause any "sparkling effect." The effect is uniform and constant gloss reduction can be achieved in clearcoats (Figure 6).

FIGURE 6 Example of a clearcoat, applied in gloss with a contrast card behind.

Does the Additive Work in Effect Powder Coatings?

Just as in solid color powder coatings and clearcoats, the additive can be used in effect powder coatings to reduce the gloss value as required (Figure 7).

FIGURE 7 Examples of effect powder coatings.



Neither the visual properties nor the durability of the effect pigments changes by its addition. A homogeneous mixture of the additive and the powder coating results in a homogeneous appearance without any disruptive color characteristics. All types of effect pigments are suitable. For aluminum pigments, leafing types or non-leafing types can be used with no difficulty. The novel additive achieves equal gloss reduction in both cases. When coating gloss measurements on metallic and effect coatings, it should be noted that the gloss values obtained do not align with the visual appearance of the gloss.

Can Textured Powder Coatings be Matted with the Additive?

For structured powder coatings, the user first needs to determine whether the structure appearance is to be "fixed" or whether it should be smoothed out during the coalescence process and then matted by the required formulation. Concentration with another powder coating quickly results in visible defects in the form of spots, particles or craters. Disturbance of the structure may occur, causing 4 to flatten. For this reason, the use of the additive in these powder coatings is limited. As can be seen in Figure 8, gloss reduction is achieved. However, the coarse structure becomes increasingly flat and loses its "orange peel" appearance. The ability of the coating structure is within a tolerable range. A series of tests using different dosages is recommended.

FIGURE 8 Images of the original coarse structure (left) and its change following incorporation of the additive (various doses).

Powder coatings with a fine texture, by contrast, can be combined very well with this additive. Fine textures are generally created with additives based on micronized PTFE (polytetrafluoroethylene). The use of the additive does not cause any disruptive effects in the coating. The gloss reduction and the reduce and no appearance changes in the characteristics of surface texture, whereby the gloss additive can be described as non-critical.

Fine textures already have a certain degree of matting. For example, the addition can be used in these formulations to make fine adjustments to the gloss value of quality control determines too high gloss values.

As can be seen in Figure 9, there is only a minimal effect on the optical appearance of the fine texture. This is important in terms of reproducing such formulations since deviations in visual appearance not accepted and can therefore lead to rejection. Corrective measures using the novel additive can be made without any problems. Even when the dosage is significantly increased, textures are given an improvement of appearance of 60° and 85°. They each show a reduced level of gloss.

FIGURE 9 Copper crae, fine texture based on micronized PTFE (dosages = 0.1% / 0.3% / 0.5%). Bottom row: each with an additional dosage of 0.5% BYK-3908 F.

Conclusion

Virtually no changes can be made to powder coatings after they have been manufactured. Where the color shades or other visual properties do not meet the requirements or the specification, corrective measures are difficult. In the worst-case scenario, the whole formulation has to be reworked and an entirely new batch has to be manufactured.

The novel BYK-3908 F allows effective gloss value reduction even in finished powder coatings using the post-addition process. This process step can be carried out easily with various types of mixing equipment and is therefore significantly more economical than conventional production. Particularly important is the time saved or alternatively used as matted systems.

For the powder coating manufacturer, the benefits of the post-addition process are to create individual gloss values quickly from just one basecoat. Basecoats that have been mixed with the additive can be stored under standard conditions.

Powder coating applicators now have new options available. They can respond to customer requirements immediately before beginning the coating process. Universal use of this novel additive means that the coater does not need to keep many different powder coatings in stock. Instead, he can give value to the adjustment to requirements at short notice. Only the common color shades need to be kept in stock as basecoats. This means long delivery times and delays in order processing can be avoided.

Regulatory constraints and safety requirements have been increasing for years. These affect the powder coating industry in selecting raw materials. A variety of labeling requirements apply when processing coating materials and during transportation of coated goods. The label-free composition of the additive means that no special safety measures are required. Moreover, the powder coating manufacturer can be outlined as strong benefit. The additive can be used in the powder coating industry without taking any additional measures.

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