Matting via controlled texturing

Ultra-low gloss combined with highest mechanical stability through the use of Deuteron ST Products
Today the formulation of durable ultra-matt coating systems (85° gloss <5) remains a tough challenge. The sensitive balance between viscosity, mechanical resistance (resistance to polishing, scratches and abrasion) and optical quality (haze, cloudiness, flow) can be challenging. With such a requirement profile, many conventional matting agents reach their limits and often lead to strong haze or high viscosity.

The use of specialized texturing additives based on polymethylurea (PMU) to formulate ultra-matt and highly scratch-resistant coatings opens up a wide range of possibilities to meet today’s requirements for ultra-matt coatings. Especially the combination with polymeric matting agents offers a huge and interesting latitude to the formulator.

In the following article we would like to examine in detail the versatile application possibilities of texturing additives in the field of matting and offer concepts to break new ground in the formulation of matt systems.

/ Relation between texture and matting

The gloss level describes the property of a surface to scatter light in a non-directional manner. The greater the scattering of the incident light, the more matt the surface appears.

Classic matting agents work by the interaction between film shrinkage and porosity/surface area of the matting agent. The resulting roughness of the paint surface depends on the particle size of the matting agent and its surface morphology.

Matting agents such as Deuteron MK show a porous surface, which additionally improves light scattering and thus significantly contributes to its efficiency. In comparison, Deuteron ST texturing additives consist of massive particles with a small surface area.

As coarse particles, texturing additives are able to roughen the coating film depending on the particle size and thus achieve a matting effect. Depending on particle size and amount added, fine or coarse matting effects can be achieved featuring interesting haptic properties and outstanding resistivity against mechanical stress.

/ Advantages of using texturing additives as matting agents

Due to the compact particle morphology, a direct comparison between texturing additives and matting agents shows a lower matting efficiency on the part of the texturing additives. The lower matting efficiency of texturing additives needs to be compensated by adding a higher dosage and/or by a combination with dedicated matting agents. However, apart from the pure matting efficiency our texturing additives show a number of advantages over traditional matting agents:

• Lowest impact on viscosity
• Less haze
• Polishing and burnishing resistant
• Scratch and abrasion resistant

/ Matting through controlled surface texturing

Toolbox for the development of ultra matt and highly resistant coatings.
Texturing additives show their full potential through synergistic effects in combination with matting agents. In addition to a strong reduction of the 85° gloss, they offer excellent protection for the sensitive matting agent particles. To achieve the best performance it is important to combine the right particle sizes. To get the best mechanical protection the texturing additive should be slightly coarser than the matting agent.

Due to their low surface area, texturing additives also show the advantage of having very little influence on the viscosity. In extreme cases, addition level of 15% are possible without affecting the final viscosity significantly. In case of combinations between texturing- and matting additives, it is recommended to not exceed a mixing ratio of 1:1. In general, a higher proportion of texturing additive is advantageous for viscosity, durability and film turbidity.

/ Formulating with texturing additives – things to consider

Since texturing additives were primarily developed to create a texture in the coating film, a number of special properties must be taken into account when creating matting effects. The most important parameters for the effect, which have to be considered during formulation:

- Particle size
- Filling level / quantity to be added
- Applied film thickness (wet and dry)
- Desired effect (85° gloss reduction, surface protection, viscosity adjustment, haptics)

When combining texturing additives and matting agents, the coarser particles of the texturing additive effectively protect the sensitive matting particles. The much more resistant texturing additive must be ground down first before the matting agent can be mechanically stressed.
Additives to your Success.

The particle size significantly determines the influence of the additive on the sheen (85° gloss) as well as on the resulting haptics. The coarser the particles, the rougher the surface and the lower the sheen. For the pure matting effect, the particle size should be adjusted to the film thickness. There is a system-dependent optimum between dry film thickness and particle size. The adjacent diagram shows the optimum particle size (mean particle size - Dv50) on the basis of the 60° gloss with 5% concentration at 50 μm and 100 μm wet film thickness.

At 50 μm wet film thickness, the optimum is in the range of 11 μm particle size.

At 100 μm wet film thickness, the optimum is between 20 μm and 32 μm particle size.

Reason for the glossiness of higher particle sizes is the particle volume and the number of particles in the coating film. Comparing the amount of particles in 1 g sample between 11 μm (Deuteron ST-M) and 45 μm (Deuteron ST-L) particles, there is a difference factor of 91 – in one gram of Deuteron ST-M there are accordingly approx. 91 times more particles than in one gram of Deuteron ST-L. Due to the smaller number of particles, gaps between the particles occur. Depending on the size of the gaps, they contribute more or less to the gloss and become visible. (Leads to a “wet look effect”).

Small amounts of texturing additive lead to a wet look and a coarse texturing effect. The glossy areas between the particles are clearly visible.

Increasing the concentration leads to higher packing density and thus to a macroscopic matting effect. Glossy areas between particles are only visible when the eye comes very close to the film. From a distance the film appears already matt.

Once the particles come almost in contact with each other the film appears to be uniform matt. Even at close distance no glossy marks are visible anymore.
Apart from the matting effect, the particle size is also decisive for the influence on the gloss at flat viewing angles - the so-called „sheen“. Typically, the aim is to find the balance between the highest possible particle size and sufficient matting. In addition, the haptic is influenced by coarse particles, too.

In order to achieve this balancing act of properties, a combination of texturing and matting additives in a mixing ratio of 2:1 to 5:1 (texture : matting) is recommended. In such a combinations both materials can support each other in a synergistic way to benefit from outstanding mechanical properties and a very even matting effect that is highly stable over all measurement angles.

In addition to particle size, the addition level plays a decisive role in the effect. Particle size and, above all, the concentration of texturing additives determine whether the coating surface looks „closed matt“ or wet and structured. The haptics are also influenced by the addition level. This influence can best be measured and represented by the roughness of the coating. The measured roughness (Rz - average depth of roughness) initially increases with increasing dosage until the particles in the film form a closed structure. As soon as this critical filling level is reached, the roughness decreases again as the film virtually becomes smooth again. This effect is caused by increased packing density.

### Graph 1

The graph shows the correlation between gloss level (60° gloss in blue and 85° gloss in red) and particle size distribution. The chart shows two different mating agents and 4 different texturing additives.

The coating was applied at 100 μm wet film thickness – 35 μm dry film thickness. When reaching a particle size of ~ 21 μm (Dv50) – Deuteron ST-G – the 60° and 85° gloss start to become almost equal. This interesting effect is caused by the micro texture and starts to appear once the particle size of the matting particle reaches approx. 60 – 70% of the dry film thickness.

### Graph 2

The surface roughness increases until an addition level of 10%. As soon as the critical filling level is reached, the surface roughness decreases again. The touch becomes significantly „softer“ and changes from rough to „velvet“.
In order to achieve the greatest possible economic efficiency, the combined use of matting agents and texturing additives is recommendable. The matting agent fills the glossy gaps between the texturing additive particles and leads to haptic and optically appealing results. The corresponding application concentrations must be determined individually depending on the used coating system.

For combinations, the texturing additive should have at least the same particle size as the matting agent. In order to achieve optimum results, the texturing additive should be significantly coarser. Deuteron ST-G and Deuteron ST-S have proven to be excellent starting points in many conventional systems.

/ Comparison of the matting efficiency

In the following graph the matting efficiency of the various Deuteron ST texturing additives will be compared to the matting agents of the Deuteron MK series. The test was carried out in a w/b 1 k PU/acrylate system. The application was done using a 100 μm wire rod bar on contrast cards.

/ Summary

The Deuteron ST texturing additives based on PMU polymers open up interesting possibilities for the formulation of matt and ultramatt systems. Our texturing additives help to extend the formulation limits in terms of viscosity, mechanical resistance and haze. They enable not only the formulation of ultra-matt coatings with a broad application spectrum, but also the use of higher-viscosity raw materials and the saving of VOCs through higher solids contents with the same viscosity. In addition Deuteron ST products are able to imitate specific tactile aspects such as the tactile feel of raw wood or paper and cardboard. Thanks to the narrow particle size distribution and carefully selected particle size, with its Deuteron ST products Deuteron offers a broad and versatile portfolio of texturing additives for various effects.