Matting and more

High efficiency matting agents with additional performance benefits.

Synthetic silica products are supplied to the coatings industry in a variety of applications. A wide range of products to fit the differing application performance requirements of the various coatings segments is available. Silica gels in particular are widely used as matting agents in paints and coatings.

Hans-Rudolf Lehnert, Norbert Wings.

The focus of this article is to introduce:
- a silica gel matting agent technology, which combines high matting efficiency with superior polishing resistance of the applied matt coating
- a test method enabling the coatings producer to get reproducible results and thus an objective qualification of the surface properties of a matt coating

Silica gel technology

Modern silica gel technology enables the production of highly pure, porous products. A silica gel is an amorphous form of silica composed of nearly 100% silicon dioxide (SiO₂) produced synthetically in a wet process. Synthetic silica gel products are non-hazardous, environmental compliant substances both from their chemistry and their physical properties and thus they are not a matter of concern regarding upcoming legislation. The process and its key parameters are sufficiently described in the literature [1,2,3].

The physical properties of silica gel differ from other types of specialty silica. The internal structure of silica gel is composed of a large network of interconnected microscopic pores that attract and hold water, hydrocarbons, and other chemicals by the mechanism of physical adsorption and capillary condensation. This huge pore volume and extensive surface area gives the silica gel many of its unique properties.

Matting agents

The function of a silica gel as a matting agent depends on the porosity of the particle and the particle size distribution. A high porosity is a key feature of a modern matting agent as it enables the formulator to limit the addition rate of a matting agent in a formulation. Unfavourable viscosity effects as well as limitations in surface properties of the coating can be avoided.

A new milestone in micronised silica gel technology for high matting efficiency was reached by the achievement of a pore volume of more than 2 ml/g [4,5]. Suppliers also offer organically treated silica gels for use as matting agents. These products are recommended for use in clear varnishes because they have somewhat better anti-settling, dispersion and, to some extent, mar resistance properties in comparison with untreated grades.

However, in many applications adequate mechanical resistance of a matt surface and reproducible test methods are an unfulfilled need in the market. To support the end-use demand of a high mechanical resistance of a coating whilst keeping the matting efficiency on a high level, a new generation of matting agents is required.

A new silica gel product concept has been recently designed specifically to improve the polishing and abrasion resistance of matt coatings [5]. It can be used as a highly efficient matting agent in a wide range of common coatings applications. Combined with a controlled particle size distribution and defined silica morphology, a special organic surface treatment provides substantial performance benefits to the coatings formulator and the end user like:
- High polishing/burnishing and abrasion resistance
- Superior chemical resistance
- Excellent Suspension behavior and long storage stability of the paint

Abrasion testing

The damage to a surface caused by polishing or abrasion is more visible at low gloss levels. Surface properties can be influenced by the selected matting agent type. However, variations in polishing and abrasion resistance are difficult to measure and quantify with commonly used test methods as they are often subjective in nature and exhibit limited reproducibility.

For the investigation of low gloss surfaces, a suitable abrasion test method in particular with high reproducibility, had not been established up to now.

To address this need the Taber Abraser equipment was modified by using a 3M "Scotch Brite" fiber pad as the abrasive medium. The test conditions applied were as follows:

- Polishing/Abrasion caused by 2 abrasive wheels
- Pressure applied to the panel surface: 9 N/cm²
- Abrasive medium: 3M "Scotch Brite" fiber web

The evaluation method used was to determine the gloss level at 20° and 60° before and after the test and to calculate change in gloss of the fresh film and the film treated with the fiber pad.

Test results with the new silica gel product concept

The modified Taber Abraser test allows a reproducible and objective comparison of polishing and abrasion resistance of low gloss surfaces. A comparative study of abrasion resistance of low gloss coatings containing the same addition level of different silica based matting agents was carried out in a commercial 2-pack PU system. The test series included untreated matting agents, wax treated matting agents as well as matting agents with coarser particle size (Figure 1).

The new silica gel product concept outperforms all untreated and treated silica matting agents tested in the modified Taber Test independent from surface treatment and particle size (Figure 2).

Typically, a higher average particle size was the only option to enhance abrasion resistance, but with the disadvantage of leading to higher surface roughness. The new silica gel product concept exhibited a higher abrasion resistance than coarser silica matting agents tested, whilst keeping a smooth surface.

Comparable results were found in different paint systems.

Improved polishing plus abrasion resistance

The newly developed silica gel product concept provides better polishing and abrasion resistance even when benchmarking against conventional coarser grades. The modified Taber test method allows reproducible measurement of polishing and abrasion resistance of low gloss coatings. The new silica gel product concept together with the proposed reproducible polishing and abrasion test method is a valuable contribution to easing the qualification process of applied coatings and meet end user requirements.

References


The authors:  
-> Dr. Hans-Rudolf Lehnert is Senior Principal Scientist R&D Coatings at Grace GmbH & Co. KG in Worms, Germany  
-> Dr. Norbert Wings is Marketing Manager Coatings at Grace GmbH & Co. KG in Worms, Germany  

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Figure 1: Taber test with coating based on a 2-pack polyurethane system (500 cycles)
Figure 2: Change in gloss units after 500 cycles in the modified Taber test (APS: average particle size)