

ACEMATT® Matting agents for the coatings industry

Technical Overview



ACEMATT® Silica

Evonik has been serving the coatings industry for more than 60 years with matting agents based on synthetic amorphous silica, meeting the constantly growing demands with intensive research and development.

As a result, Evonik consistently developed new matting agents with specific properties. Whether its for purely aesthetic reasons, to increase product safety or for general product improvement, the increasing demand for matted coating systems has resulted in the targeted development of silica for creating matt surfaces.

This publication focuses on the physico-chemical properties of ACEMATT® products and their applications. It also provides practical information pertaining to their use.

The Applied Technology department of the Business Line Silica will gladly provide additional information and assist in the preparation of formulations.

All data contained in this brochure is based on approximate values under lab conditions.

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1 Product overview and nomenclature

Evonik Industries offers a variety of matting agents designed for the coatings industry and known under the ACEMATT® brand since 1995. Among others the following nomenclature applied:

- **T** stands for thermal silica
- **H** stands for precipitated silica from the aqueous phase (hydro = water)
- **O** stands for surface-treated products
- **K** stands for Kieselsäure (German for silica)
- **S** stands for silica in the case of ACEMATT® TS 100

2 Fundamental requirements for matting agents

- Easy dispersibility
- Good suspension behaviour in liquid coating systems
- Must work with most coating systems
- High matting power with small amounts
- Easily adjustable to any desired degree of matting
- Little influence on rheological properties
- Must have little influence on the coated surfaces due to mechanical and chemical stress
- Coating keeps high transparency
- Consistent quality
- Must be chemically inert



Figure 1 symbolizes the variety of the products of the ACEMATT® matting agent family

3 ACEMATT® product range

3.1 Brief description and properties

3.1.1 Precipitated silica

<p>ACEMATT® 82* Economical, special purpose, untreated matting agent with a heterogeneous particle size distribution. Average agglomerate particle size: 7.0 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® 82 is an untreated precipitated silica. This highly efficient matting agent is especially suitable for pigmented systems with low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in decorative and industrial coatings.</p>
<p>ACEMATT® HK 125 Economical, special purpose, untreated matting agent with a heterogeneous particle size distribution. Average agglomerate particle size: 11.0 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® HK 125 is an untreated coarse-grained precipitated silica with heterogeneous particle size distribution. This efficient matting agent is particularly suitable for pigmented systems with low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in wood and decorative coatings.</p>
<p>ACEMATT® HK 400 All-purpose untreated matting agent. Average agglomerate particle size: 6.3 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® HK 400 is an untreated fine-grained precipitated silica. This efficient matting agent is especially suitable for pigmented systems. It is often used in can and coil coatings, decorative coatings, wood coatings and industrial coatings.</p>
<p>ACEMATT® HK 440 Untreated matting agent manufactured using a newly developed process. Average agglomerate particle size: 14.5 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® HK 440 is an untreated, extremely coarse-grained precipitated silica. This highly efficient matting agent is especially suitable for pigmented systems with extremely low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in decorative coatings, thick film coatings, base coats and industrial coatings.</p>
<p>ACEMATT® HK 450 Untreated matting agent manufactured using a newly developed process. Average agglomerate particle size: 10.5 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® HK 450 is an untreated coarse-grained precipitated silica. This highly efficient matting agent is especially suitable for pigmented systems with low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in can and coil coatings, decorative and industrial coatings.</p>
<p>ACEMATT® 790 Untreated matting agent manufactured using a newly developed process Average agglomerate particle size: 7.0 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® 790 is an untreated precipitated silica of medium particle size. This highly efficient matting agent is especially suitable for pigmented systems with low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in can and coil coatings, decorative and industrial coatings.</p>
<p>ACEMATT® 810 Untreated matting agent manufactured using a newly developed process Average agglomerate particle size: 10.5 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® 810 is an untreated coarse-grained precipitated silica. This highly efficient matting agent is especially suitable for pigmented systems with low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in can and coil coatings, decorative and industrial coatings.</p>
<p>ACEMATT® 3600 Fine-grained, treated matting agent designed for low gloss radiation curable coatings. Average agglomerate particle size: 5.0 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® 3600 is an extremely fine-grained precipitated silica, after-treated with a special polymer. This matting agent has been specially developed for 100% radically curing UV-coatings. The coating films obtained have the highest surface smoothness. ACEMATT® 3600 is particularly distinguished by its very low thickening effect and very good chemical resistance. It is excellently suited for use in very thin film and very thick film UV-coatings.</p>
<p>ACEMATT® OK 412 and ACEMATT® OK 500 All-purpose matting agent with organic surface-treatment. Average agglomerate particle size: 6.3 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® OK 412 and ACEMATT® OK 500 are fine-grained precipitated silica, after-treated with wax. These efficient matting agents are suitable for unpigmented and pigmented systems. Due to the excellent suspension behavior they are especially suitable for clear coatings. The coating films obtained have excellent surface smoothness. Thanks to their property profile, ACEMATT® OK 412 and ACEMATT® OK 500 are highly versatile. In case ACEMATT® OK 412 gives rise to drying delays, we recommend the use of ACEMATT® OK 500.</p>
<p>ACEMATT® OK 520 All-purpose matting agent with organic surface-treatment. Average agglomerate particle size: 6.5 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® OK 520 is a fine-grained precipitated silica, after-treated with wax. This highly efficient matting agent is suitable for unpigmented and pigmented systems. Due to its excellent suspension behavior it is especially suitable for clear coatings. The coating films obtained have high surface smoothness. ACEMATT® OK 520 is particularly distinguished by its good suitability for use also in water-based coatings and impresses by its high transparency and very good chemical resistance.</p>

* Regionally available in Asia/Pacific

<p>ACEMATT® OK 607 Very fine-grained matting agent with organic surface-treatment. Average agglomerate particle size: 4.4 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® OK 607 is a very fine-grained precipitated silica, after-treated with wax. This efficient matting agent is suitable for unpigmented and pigmented systems. Due to its excellent suspension behavior, it is especially suitable for clear coatings. The coating films obtained have the highest surface smoothness. ACEMATT® OK 607 is particularly distinguished by its high sheen (85°-reflectometer value - 60°-reflectometer value). It is excellently suited for use in thin film coatings.</p>
<p>ACEMATT® OK 900* Special purpose matting agent with organic surface treatment. Average agglomerate particle size: 7.5 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® OK 900 is a medium-grained precipitated silica, after-treated with wax. This very efficient matting agent is particularly suitable for pigmented coatings systems with low sheen (85°-reflectometer value - 60°-reflectometer value). It is often used in can and coil coatings as well as in industrial coatings.</p>

* Not available in the US

3.1.2 Thermal silica

Thermally manufactured silica differ from wet process products mainly in the amount of adsorbed and chemically bound water. As a rule, this product group has a low drying loss (2 hrs at

105 °C) and a lower ignition loss (2 hrs at 1000 °C) [1, 2]. These factors are relevant, for example, for PU-systems and for transparent coatings.

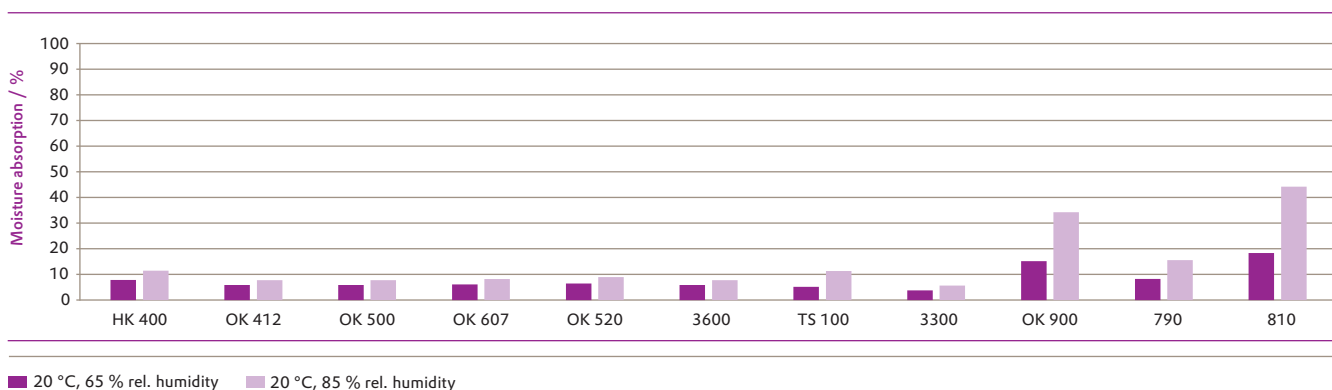
<p>ACEMATT® TS 100 Thermal, untreated silica Average agglomerate particle size: 9.5 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® TS 100 is a fumed silica that is not surface treated. This matting agent is distinguished by excellent matting efficiency combined with the highest transparency. Thanks to its unique property profile, it is particularly suitable for coatings that are not easily matted. Particularly noteworthy is its use in water-based coatings, waterborne UV-coatings, clear coatings, and coatings for leather, artificial leather, and foils, as well as top coats of all types. ACEMATT® TS 100 allows formulation of coatings with outstanding resistance to household chemicals. Due to its high purity and extremely low electrical conductivity, ACEMATT® TS 100 is excellently suited for use in correspondingly sensitive coating systems such as solder resist. ACEMATT® TS 100 improves flow behavior and increases storage stability in powder coatings.</p>
<p>ACEMATT® 3300 Thermal, treated silica Average agglomerate particle size: 10.0 µm d₅₀ (laser diffraction)</p>	<p>ACEMATT® 3300 is a fumed silica, after-treated with a special polymer. This matting agent is distinguished by the highest matting efficiency combined with high transparency. It has been developed specifically for use in soft-feel coatings with the most sophisticated haptics. Particularly noteworthy is its use in water-based coatings, waterborne UV-coatings, clear coatings, and coatings for leather, artificial leather, and foils, as well as top coats of all types. ACEMATT® 3300 allows formulation of coatings with outstanding resistance to household chemicals. When used in waterborne formulations, adsorption of associative thickeners is minimal so that excellent rheological stability is achieved.</p>

3.2 Moisture absorption

ACEMATT® standards guarantee specified drying losses when the product leaves the plant. The original packaging provides considerable protection from moisture uptake.

However, particularly in wet climates, proper treatment is essential during shipping, storage and handling. Figures 2 show the maximum moisture uptake of ACEMATT® products at different humidity levels.

Figure 2 Moisture absorption of ACEMATT® at various humidity levels



3.3 Quality control

Control of production is performed in defined intervals during production of the ACEMATT® products.

Quality Assurance is performed for each batch not only by determination of the physico-chemical parameters relevant for product release, but also by conducting performance checks of application characteristics in various coatings systems, including:

- Wetting
- Dispersibility
- Flow behaviour
- Suspension behaviour
- Matting efficiency
- Transparency
- Surface roughness

Of course, all our sites are certified according to ISO 9001. Above that we have set the target of zero defects. Through a pro-active, modern management system, that emphasizes error prevention over error control, we will realize this goal.

3.4 Physico-chemical data*

Table 1 Physico-chemical data

Properties and Test Methods	Unit	ACEMATT®														
		82	HK 125	HK 400	HK 440	HK 450	790	810	3300	3600	OK 412	OK 500	OK 520	OK 607	OK 900	TS 100
Specific surface area (N ₂) Multipoint following ISO 9277	m ² /g	250	180	200	500	500	275	500	190	110	130	130	220	130	370	250
DOA absorption ¹ internal method	ml/100g	265	200	275	270	270	260	280	-	255	240	240	295	245	245	-
Particle Size. d ₅₀ Laser diffraction (Coulter LS) following ISO 13320-1	µm	7.0	11.0	6.3	14.5	10.5	7.0	10.5	-	5.0	6.3	6.3	6.5	4.4	7.5	-
Particle Size. d ₅₀ Laser diffraction (Cilas) following ISO 13320-1	µm	-	-	-	-	-	-	-	10.0	-	-	-	-	-	-	9.5
Average grind value **	µm	25	39	27	43	33	24	33	38	17	27	27	29	18	23	40
Surface Treatment		-	-	-	-	-	-	-	organic	organic	organic	organic	organic	organic	organic	-
Loss on drying 2 h at 105°C following ISO 787-2	%	≤9.0	≤6.0	≤6.0	≤6.0	≤6.0	≤7.0	≤7.0	≤4.0	≤6.0	≤6.0	≤6.0	≤6.0	≤6.0	≤7.0	≤4.0
Loss on ignition ² 2 h at 1000°C following ISO 3262-1	%	≤4.0	≤6.0	≤6.0	≤6.5	≤6.5	≤6.0	≤6.5	≤6.0	≤7.0	≤13.0	≤13.0	≤13.0	≤13.0	≤13.0	≤2.5
Carbon content elemental analyser LECO following ISO 3262-19	%	-	-	-	-	-	-	-	3.0	3.0	5.5	5.5	4.5	5.5	4.2	-
pH value 5% in water following ISO 787-9		5.0	6.6	6.6	6.0	6.0	6.8	6.0	7.7 ⁴	6.6	6.3	6.3	6.0	6.3	6.5	6.5
SiO ₂ content ³ following ISO 3262-19	%	≥98	≥98	≥98	≥98	≥98	≥98	≥98	≥99	≥98	≥98	≥98	≥98	≥98	≥97	≥99
Sulfate content ¹ internal method	%	≤0.2	≤1	≤1	≤1	≤1	n. s.	≤1	n. a.	≤1	≤1	≤1	≤1	≤1	≤1	n. a.
Package size (net)	kg	15	15	15	10	10	10	15	10	12.5	15	15	10	15	12.5	10

¹ based on original substance

² based on dry substance (2 h / 105 °C)

³ based on ignited substance (2 h / 1000 °C)

⁴ 5% in water / methanole 1:1

* The given data are approximate values. Specifications on request

** Depending on concentration and coating system

n.a. = not applicable

n.s. = not specified

4 Main application fields for ACEMATT®

Table 2 Applications

Application	ACEMATT®														Matting agent requirements
	HK 125	HK 400	HK 440	HK 450	790	810	3600	OK 412	OK 500	OK 520	OK 607	OK 900	TS 100	3300	
Wood, clear (painter-lacquers, stains)								●	●	●	●		●	●	Transparency, surface finish, chemical resistance
Wood, pigmented (painter-lacquers, stains)		●		●	●	●		●	●	●	●	●	●	●	Efficiency, surface finish, chemical resistance
Wood Industrial, clear (Furniture, parquet, stains)							●	●	●	●	●		●	●	Transparency, surface finish, chemical resistance
Wood Industrial, pigmented (Furniture, parquet, stains)		●		●	●	●		●	●	●	●	●	●	●	Efficiency, surface finish, chemical resistance
Flooring	●	●	●	●	●	●		●	●	●		●	●	●	Abrasion resistance, chemical resistance, non-slip safety
Industrial		●	●	●	●	●		●	●	●	●	●	●	●	Efficiency, surface finish
Automotive		●			●			●	●	●	●	●	●	●	Efficiency, surface finish, polishing resistance, chemical resistance
Can Coating		●			●			●	●	●	●	●			Chemical resistance
Coil Coating	●	●	●	●	●	●		●	●	●		●			Efficiency, non-glaring, Chemical resistance
Leather		●						●	●	●	●		●	●	Surface finish, transparency, high jetness
UV							●	●	●	●			●	●	Surface finish, transparency, low thickening effect
Plastics		●						●	●	●	●		●	●	Surface finish, transparency, high jetness
Printing Inks															
Relief Flexo (OPV*)		●			●		●	●	●		●	●	●		Transparency, low thickening effect, efficiency
Gravure (OPV*)		●			●		●	●	●		●	●	●		Transparency, low thickening effect, efficiency
Off-set (OPV*)							●	●	●		●				Transparency, efficiency, surface finish
Silk / Screen Printing							●	●	●				●	●	Efficiency

OPV* = Overprint-Varnishes

● Very suitable ● Suitable

Table 3 Systems

ACEMATT®															
System	HK 125	HK 400	HK 440	HK 450	790	810	3600	OK 412	OK 500	OK 520	OK 607	OK 900	TS 100	3300	Matting agent requirements
2K-PU, clear, solvent								●	●	●	●	●	●	●	Transparency, surface finish, chemical resistance, storage stability
														●	Soft-Touch
2K-PU, pigmented, solvent		●		●	●	●		●	●	●	●	●	●	●	Surface finish, chemical resistance
2K-PU, clear, waterborne								●	●	●	●		●	●	Surface finish, chemical resistance
														●	Very low thickener adsorption
														●	Soft-Touch
2K-PU, pigmented, waterborne		●			●			●	●	●	●	●	●	●	Transparency, surface finish, chemical resistance, storage stability
														●	Very low thickener adsorption
1K-PU, clear, waterborne								●	●	●	●		●	●	Transparency, surface finish, chemical resistance, storage stability
														●	Very low thickener adsorption
														●	Soft-Touch
1K-PU, pigmented, waterborne		●			●			●	●	●	●	●	●	●	Surface finish, chemical resistance
														●	Very low thickener adsorption
Acrylate, clear, waterborne								●	●	●	●		●	●	Transparency, surface finish, chemical resistance, storage stability
														●	Very low thickener adsorption
Acrylate, pigmented, waterborne		●			●			●	●	●	●	●	●	●	Surface finish, chemical resistance
														●	Very low thickener adsorption
Epoxy	●	●	●	●	●	●		●	●	●		●	●	●	Abrasion resistance, chemical resistance, non-slip safety
Alkyd-Melamine		●		●	●	●		●	●	●	●	●	●	●	Efficiency, surface finish
Acrylate-Melamine				●	●	●		●	●	●		●			Surface finish, non-glaring, chemical resistance
Polyester-Melamine				●	●	●		●	●	●		●			Surface finish, non-glaring, chemical resistance
Alkyd Decorative Coating	●	●	●	●	●	●		●	●	●		●		●	Efficiency, good matting at high dft
UV, Acrylate (100%)							●	●	●	●	●				Surface finish, transparency, low thickening effect
UV, Acrylate, solvent- and waterbased							●	●	●	●	●		●	●	Surface finish, transparency

● Very suitable ○ Suitable

Evonik matting agents are highly versatile. However, different products deliver specific benefits due to the diverse particle size spectra and other parameters, depending on the coating system—as shown in Table 2.

This becomes clear when comparing the SEM pictures of ACEMATT® OK 607, ACEMATT® HK 400, ACEMATT® HK 450 and ACEMATT® TS 100 in the Figures 3–6, showing different particle sizes.

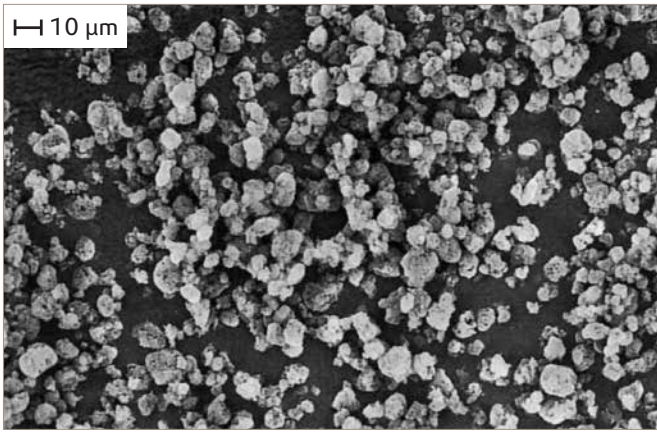


Figure 3 SEM photo of ACEMATT® OK 607

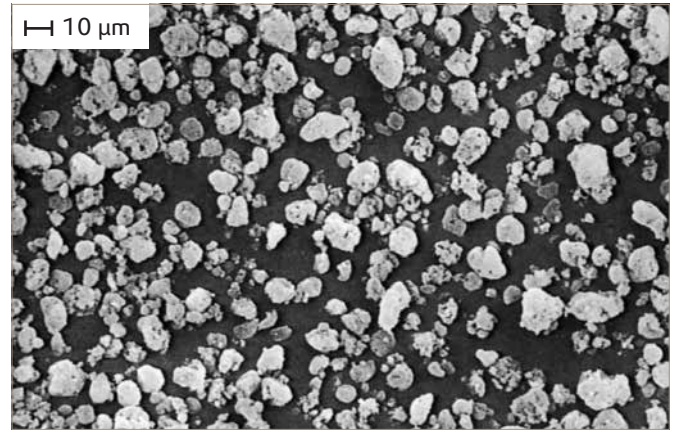


Figure 4 SEM photo of ACEMATT® HK 400

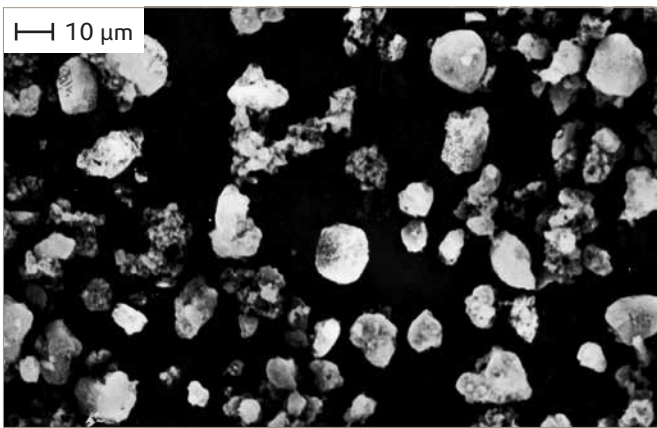


Figure 5 SEM photo of ACEMATT® HK 450

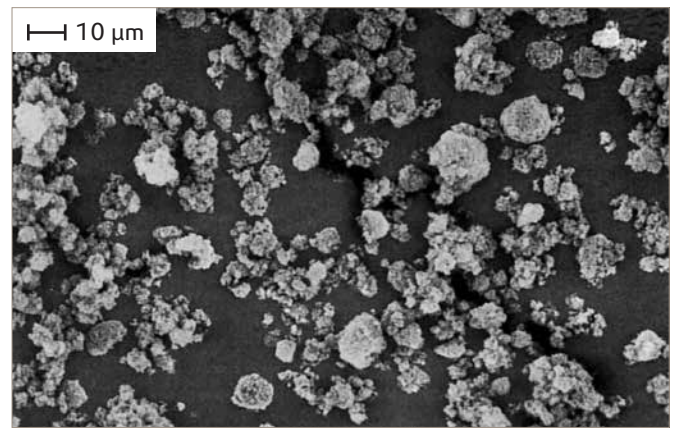


Figure 6 SEM photo of ACEMATT® TS 100

5 Gloss and matting

5.1 Definition of matting

Gloss results when two physical conditions that relate to "the direction of light" [3], [4], [5] are fulfilled:

- The illumination of the surface is predominantly directed
- The reflected light is partially directed.

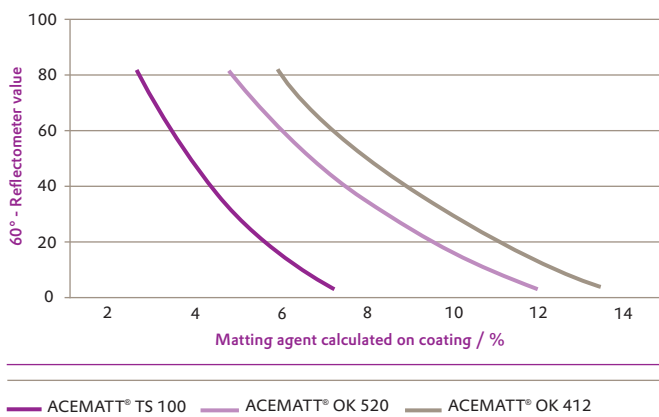
If these conditions are met, a more or less concentrated ray of light is emitted from a glossy surface, causing stimulation of the human eye [6]. Further processing of this stimulus in the brain produces the perception of gloss. Thus, from a qualitative standpoint, gloss can be defined as a physiological-optical phenomenon produced by the surface of an object [7].

Note in particular that some observers visually evaluate gloss from different standpoints [8]. Physiological factors play a part in this [9]. There is no definition of a „normal gloss observer“ in analogy to the „normal color observer“ according to DIN 5033 [10]. Over the years, however, various degrees of gloss have been defined to connect physical measurements with visual gloss perception.

Figure 7 shows, in a coating system, the differences in degree of gloss resulted by matting agents of different agglomerate particle size as a function of the amount added.

Figure 7

Influence of matting agent concentration on achievable degree of gloss in a difficult to matt 2K-PU coating. As a rule, a lower degree of gloss corresponds to greater roughening of the surface.

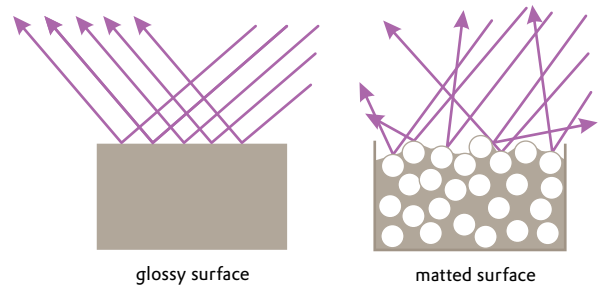


Proposals by Hunter [11], [12], [13] are best known and most widely adopted, because they enable a series of various test patterns to be established reproducibly. However, if samples of different colors, are being compared the color stimulus has a major influence on the gloss perception. For example, if a black body and a white body produce physically the same surface reflection, the black body is categorized visually as considerably less glossy [14]. This black body eliminates color effects with which an observer hardly makes an association with "gloss."

As is the case with the term "gloss" and its measurement, there is naturally no definition of the term "matt." The quantitative establishment of the "degree of mattness" of a certain system is always based on the comparative measurement of the gloss against a standard. Fundamental optics and coatings are discussed in [15–18]. On coating surfaces, the term "gloss" means almost complete reflection [19] in the sense that the surface reflects and scatters incident light in a more or less wide-angle cone. The greater the cone angle, the less gloss is generally observed (see Figure 8).

Figure 8 is a schematic illustration of the difference between a glossy surface and a matted surface in terms of reflection behaviour.

Figure 8 Reflection of light on a glossy (left) and matted (right) surface.

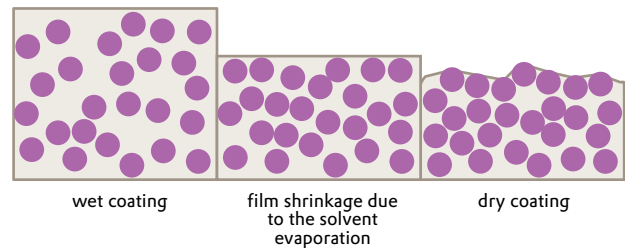


5.2 Matting—How it works!

Figure 9 illustrates how, after a coating is applied to a substrate, the matting agent is uniformly distributed in the wet coating film. As the solvent evaporates the film thickness of the coating decreases and the film "shrinks". This produces a more or less rough surface (cf. Section 7.6).

Figure 9

Schematic representation of the formation of a matted coating film at the same matting agent concentration.



Figures 10 through 12 show a reflected light photograph, SEM photograph and TEM photograph, respectively, of this roughening. Oriented incident light undergoes diffuse reflection at the surface of a body roughened in this way, creating the matt impression. These figures cannot be provided on the same enlargement scale because of the different measuring techniques.

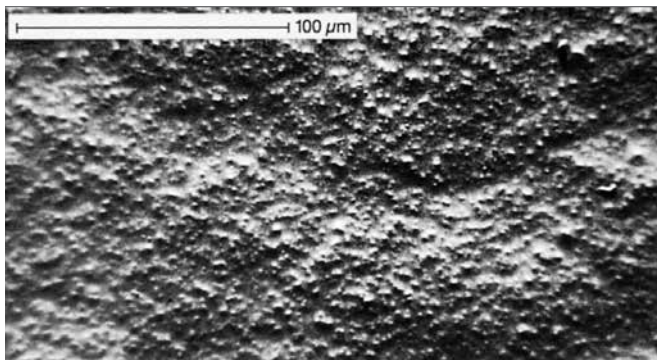


Figure 10
Photograph of a 2K-PU coating film with 14.5 wt % ACEMATT® HK 400, taken with oblique reflected illumination.

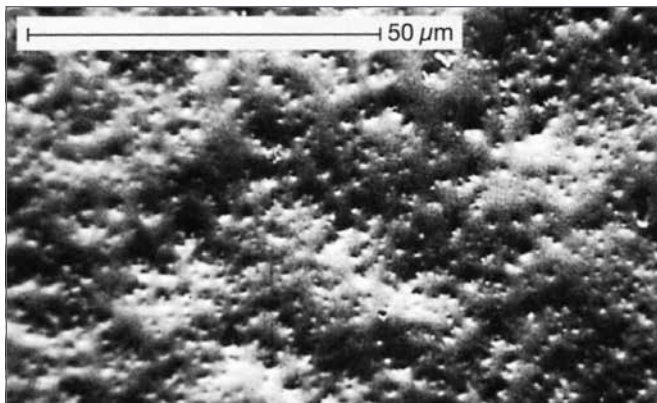


Figure 11
SEM photograph of the surface of the coating shown in Figure 10.

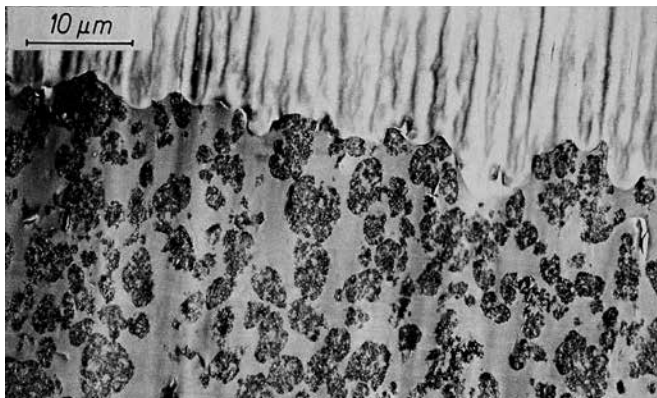


Figure 12
TEM photograph of a thin cross-section of a 2K-PU coating matted with ACEMATT® OK 412.

The theoretical principles [20, 21] of the scattering of light at rough surfaces have been known since 1926/1928. Figure 13 shows the topographic representation of the surface of a coating film matted with ACEMATT® OK 412. The horizontal dimensions are 0.25 x 0.25 mm. The vertical dimension is increased by a factor of 12.

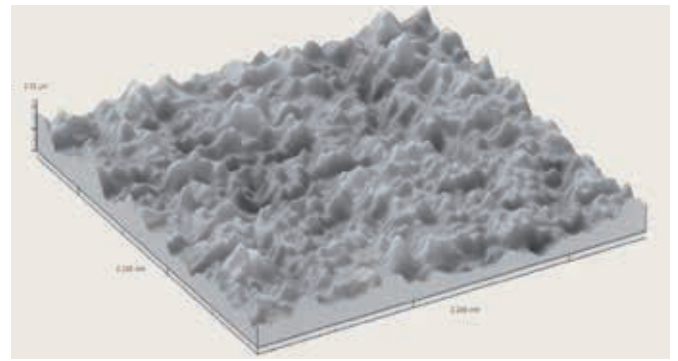


Figure 13
Hommeltester T 8000 contact analysis. Topographic surface representation of a coating film matted with ACEMATT® OK 412.

6 Parameters influencing matting

The formation of a coating film surface with a defined roughness and hence, the degree of matting, can be influenced by many factors. The phase of solvent evaporation and the associated film shrinkage are of particular relevance. Here we describe parameters such as application process, drying temperature, humidity, solvent composition and additives. Note that these are given only by way of example. In practice, effects can be annulled, superposed or enhanced. Due to the wide array of existing coating systems, it is practically impossible to make generally applicable statements.

6.1 Average agglomerate particle size

The degree of matting achieved is determined essentially by the degree of roughening of a coating film surface. Matting is increased by an elevated dose of matting agent. Generally speaking, silica with a coarser particle size distribution produce rougher, matt coating films. In coating systems with lower binder concentrations, i. e. –with high solvent content, the differences in average agglomerate particle size are less prominent than with higher binder concentrations.

The influence of particle size on reflectometer values at different angles of observation is discussed in Section 7.2. There is a wider particle size distribution in the powder than in the coating film. This fact confirms the good dispersibility of ACEMATT® products in a coating system, i. e., wetting, distribution and stabilization in terms of the degree of dispersion achieved. The average agglomerate particle size, as given by the physico-chemical characteristics, represents only an estimated value intended to enable the technician to select coarser or more finely-divided matting agents for a given application.

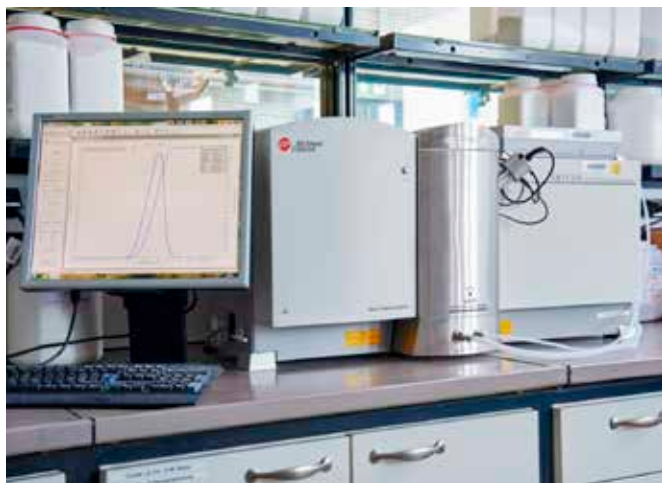


Figure 14
Determination of particle size and particle size distribution by laser diffraction (Coulter LS).

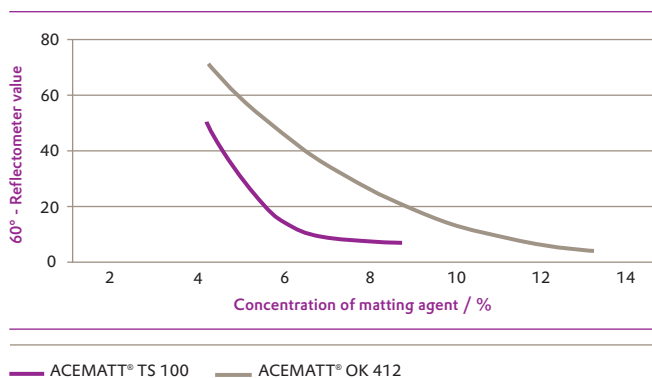
In the past, the average agglomerate particle size was determined primarily by the TEM method. However, laser diffraction is a considerably faster and more straightforward method and is currently preferred. It determines both average agglomerate particle size and particle size distribution (Figure 14).

Unfortunately, different determination methods used by matting agent manufacturers do not result in comparable values. We have to point out that one cannot directly infer the grindometer value achieved from the agglomerate particle size of the matting agent. The granularity of a coating can be determined with the grindometer according to DIN EN ISO 1524; it is influenced essentially by the degree of dispersion and the wetting behaviour of the coating system. This test method is used both for matting agents and pigments as well as fillers.

6.2 Matting agent concentration

As we can see in Figure 15, the matting action increases with increasing quantity of matting agent. Of all the parameters, this one most clearly influences matting.

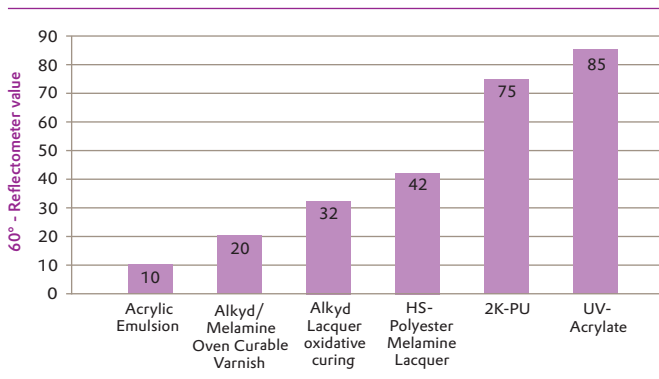
Figure 15
Degree of gloss as a function of the concentration of different ACEMATT® products in an acid-curing coating.



6.3 Type of coating system

Both the wetting behaviour of the binders used in a coating system and the solids content influence the degree of matting or the way of matting a system. Thus, it has long been known [22] that there are systems that can be “easily” matted and also systems in which gloss reduction involves considerable difficulties. The latter group includes, for example, polyurethane coatings, unsaturated polyester coatings, oxidative curing alkyd resin coatings and UV-curing coatings. This is illustrated in Figure 16.

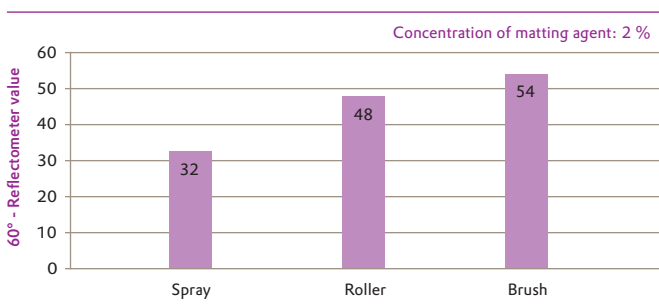
Figure 16
Matting of different coating systems with 10% ACEMATT® OK 412 added (referred to binder on coatings).



6.4 Application processes

For a given formulation, the achievable degree of matting depends on the application process. Figure 17 shows the achievable gloss for a polyurethane coating with 2 wt % ACEMATT® TS 100 in each case. The differences are considerable in some cases.

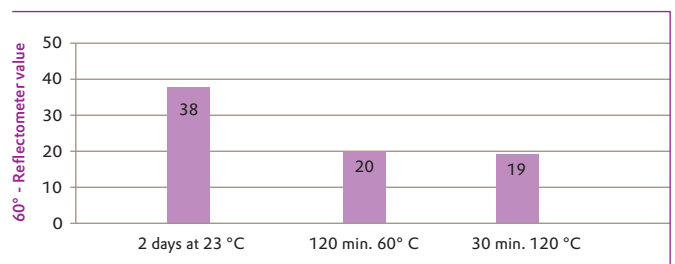
Figure 17
Comparison of different application processes for 2K-PU coating matted with 2% ACEMATT® TS 100.



6.5 Drying temperature

The speed of solvent evaporation and film-forming play a key role in the degree of roughening of the film surface. Besides these two processes, the rheology of the coating and the suspension behaviour of the matting agents influence the degree of roughening. The diffusion and convection processes occurring during the drying of the coating are determined by both temperature and humidity. Figure 18 shows the degree of gloss of a 2K-PU coating as a function of drying temperature.

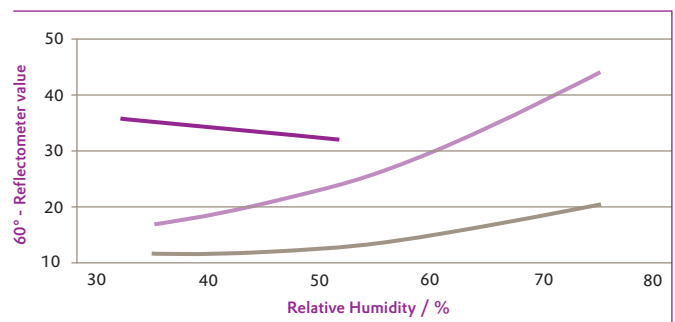
Figure 18
Influence of drying conditions on degree of matting of a 2K-PU coating matted with ACEMATT® OK 412.



6.6 Humidity

Besides temperature, relative humidity is an important parameter that can have a crucial influence on the matting of coatings during the solvent evaporation phase. As we can see in Figure 19, binders differ both in their tendency and in their sensitivity to relative humidity. The example of 2K-PU coatings illustrates that the influence of humidity can be reduced by forced drying.

Figure 19
Influence of relative humidity during the evaporation phase on the gloss of ACEMATT® TS 100-matted alkyd/melamine EB coating and 2K-PU coating at constant temperature, T = 20°C, 50°C respectively.



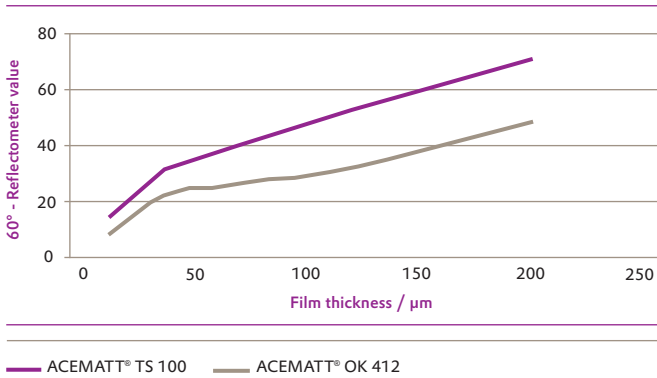
— Alkyd-/Melamine Oven Curable Varnish
— Drying at 20°C, 2K-PU Coating
— Force Drying at 50°C, 2K-PU Coating

6.7 Coating thickness

It is known that thicker coatings generally require more matting agent. A dry coating film is determined by the thickness of the wet film applied and by the solid content of the coating material. The lower the dry film thickness, the more matting agent particles are active on the surface and the higher the degree of matting. However, the higher the solid content of a coating material and hence the greater the dry film thickness, the more chance the matting agent particles have to achieve energetically favorable arrangements in the coating at equal concentration. Hence, they are not effective in roughening the surface, and the coating film looks glossier. In order to adjust an equivalent degree of matting, a larger amount of matting agent is needed. This holds particularly true of systems with a solid content of > 70%. **Figure 20** shows the achievable degrees of matting as a function of coating thickness as illustrated by the example of a baking enamel.

Figure 20

Influence of coating thickness on the achievable degree of matting for a baking enamel. The matting agent concentrations are 10% for ACEMATT® OK 412 and 5% for ACEMATT® TS 100. The specified film thickness corresponds to the blade gap.

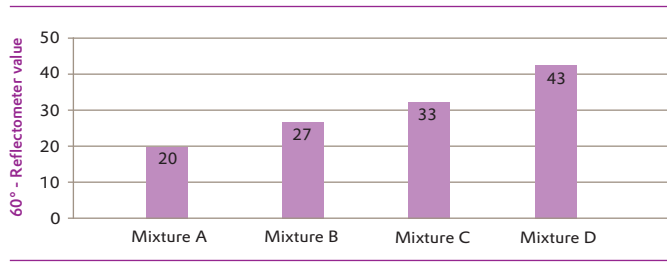


6.8 Solvents

Using a 2K-PU system as an example, **Figure 21** shows how the choice of solvent blend affects the matting result. Blends A through D contain different proportions of methyl acetate, ethyl acetate, butyl acetate, butoxyl, methoxypropyl acetate, ethoxypropyl acetate, xylene and Shellsol A.

Figure 21

Influence of different solvents on the gloss of a 2K-PU coating.

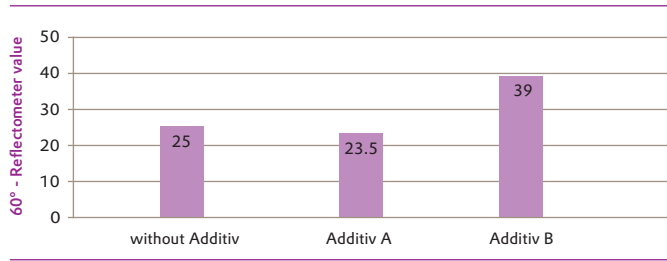


6.9 Additives

Coating additives can also have a crucial effect on the matting agent's effectiveness in the coating system. **Figure 22** illustrates the influence of 2 wetting agents on the matting effect of a high-solid coating.

Figure 22

A: Silicone-free additive, **B:** Silicone-containing additive



6.10 Dispersion

Like many pigments, matting silica have a distinct tendency to agglomerate because of their relatively high specific surface. Sufficient dispersion is important for optimum utilization of matting agents. However, silica-based matting agents are also known to lose effectiveness from excess dispersion (over grinding) and matting agent manufacturers are concerned with keeping the particle size distribution within narrow limits. Thus, because of a special manufacturing of silica, ACEMATT® matting agents can be easily incorporated into coating systems.

With few exceptions, such matting agents can be adequately dispersed by stirring them into the finished coating using a dissolver. In the field, the grindometer value according to DIN EN ISO 1524 provides the first important clue about the state of dispersion of a matted coating (see Figure 23). Depending on the type and concentration of the matting agent, the values can range from 15 to 50 µm. Other information on dispersion can be found in Section 7.1.

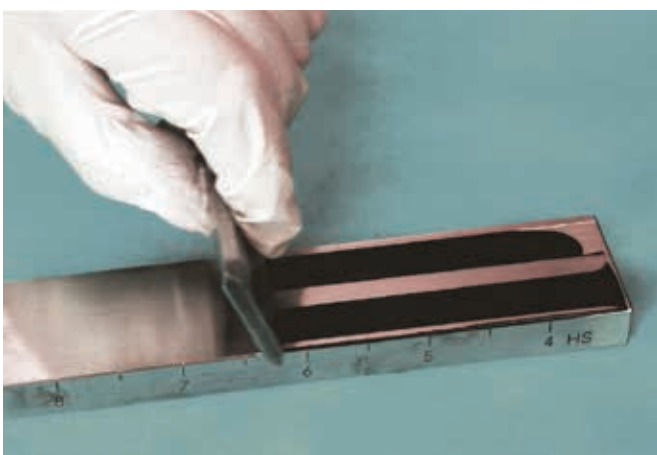


Figure 23
Grindometer block, 0–50 µm or 8–4 Hegmann units.

6.11 Substrates

When absorptive substrates, e. g., wood with large pores, are coated with matt coatings, an undesired segregation of matting agent particles on the coating surface can occur, possibly resulting in brightening and reduced gloss of the surface, as shown in Figure 24. This effect is due to penetration of the binder solution into the pores of the substrate. When this happens, the silica particles are enriched at the film surface due to the filter effect of the wood. This effect can be reduced by thixotropizing the matt coating by adding small amounts of AEROSIL® R 972, for instance.

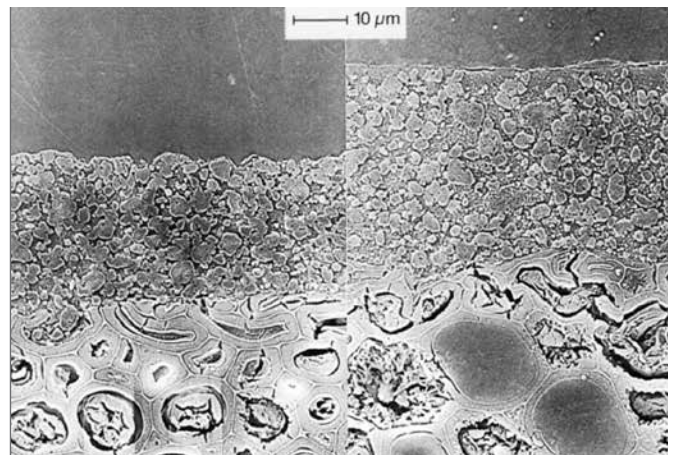


Figure 24
Cross-section of matted film surfaces (substrate: porous wood).
Left: Silica particles left unwetted due to binder depletion at the coating surface
Right: Sufficient wetting of the silica particles; intact matted surface

7 Practical hints

7.1 Dispersion

The best dispersion with a dissolver is achieved when both the geometry of the working vessel and the diameter and peripheral speed of the dissolver disk and its distance from the bottom as well as the flow properties of the grinding base correspond with each other (see Table 4).

At the ratio of disk diameter to container diameter indicated in Table 4 and at the recommended disk immersion depth and circumferential speeds, no dead zones occur inside the container and the motion of the material being dispersed is not turbulent. The rolling motion of the material being dispersed forms a cone at the tip of which the edge of the disk can be seen. This flow pattern is referred to as a so-called donut effect. The motion and the relatively high viscosities of the batch of coating material cause shear forces in the coating material that distribute the matting agent.

Table 4
Recommended equipment dimensions for dispersion with the dissolver.

Disc diameter:	D
Container diameter:	2 D – 3 D (preferably 2.3 D – 2.7 D)
Filling height of the mill base:	1 D – 2 D
Height of the stirrer disk above the container bottom:	0.5 D – 1.0 D (preferably 0.5 D – 0.7 D)
Stirring speed (circumferential speed of the disk)	18–25 m/sec
A circumferential speed of 5–10 m/sec is generally sufficient for a dispersion of ACEMATT®	

After mixing the binder solution with an ACEMATT® product, the grinding base should be subjected to turbulence-free motion by elevating the rotational speed until no dead zones are visible on the wall of the container. A certain peripheral speed of the dissolver disk is necessary to achieve this state. Table 5 shows the peripheral speeds for some dissolver diameters and the rotational speeds of the stirrer.

Table 5
Calculated peripheral speeds of the dissolver disk at a given disk diameter and rpm in laboratory use.

Dissolver Disc diameter in mm	Circum- ference in mm	Rotational speed min ⁻¹					
		1000	1500	2000	2500	3000	5000
Peripheral speed m/sec							
30	94.2	1.6	2.4	3.1	3.9	4.7	7.9
50	157.1	2.6	3.9	5.2	6.5	7.9	13.1
70	219.9	3.7	5.5	7.3	9.2	11.0	18.3
100	314.2	5.2	7.9	10.5	13.1	15.7	26.2

All ACEMATT® products are easy to process. They can be thoroughly dispersed in any paint with a dissolver or high-speed stirrer within a relatively short time. As mentioned in section 6.10, high-shear dissolvers should either not be used or should be used only in exceptional cases. These dissolvers may be necessary when special standards are imposed on the smoothness of the matt surface. Only in such exceptional cases should the Evonik ACEMATT® products be briefly dispersed, e. g. 4–6 hrs in a ball mill or with one run in the bead mill.



Figure 25 Dissolver disk

Figure 26 shows, for some ACEMATT® grades, the matting effect achieved as a function of stirring time. Only minor differences are observed among the individual matting agents in terms of grinding stability.

Figure 26

Coil coating with different matting agents with comparable starting gloss as a function of dispersion time at a constant stirring speed of appr. 5 m/sec.

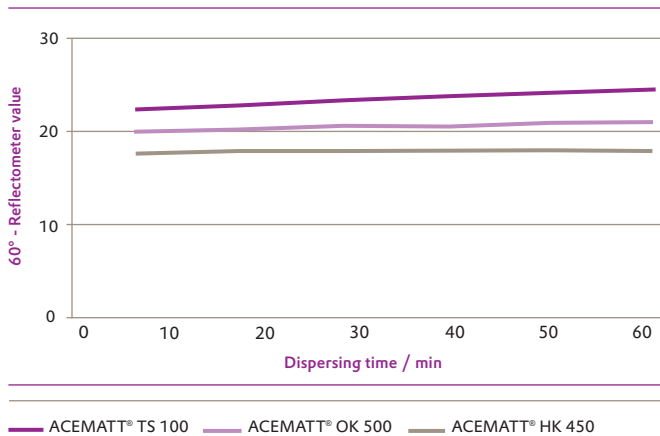
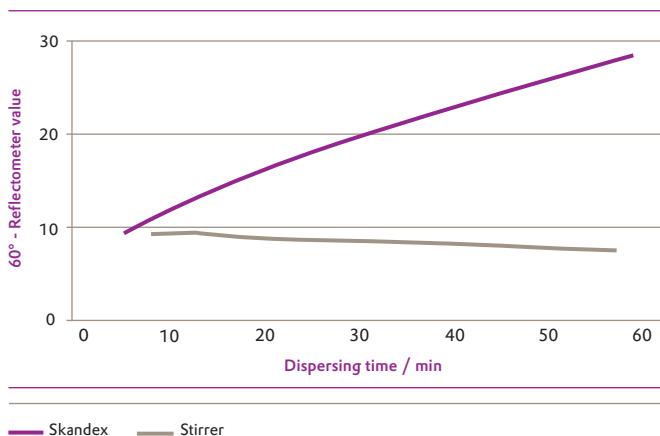


Figure 27 also illustrates, the relatively high grinding stability of ACEMATT® OK 412 in a coil coating enamel. The stronger grinding influence of the skandex in comparison to dispersion with a stirrer is also shown. We see that the dispersion conditions must be precisely established and maintained to achieve a specific degree of gloss.

Figure 27

Degree of gloss as a function of the dispersing conditions in a coil coating matted with 3 wt. % ACEMATT® OK 412.



Optimizing the grinding base composition is an important consideration, particularly when it comes to the advantage of ACEMATT® TS 100. This is clearly shown in Figure 28 using the example of a leather coating based on a non-reactive linear polyurethane. The left side of this figure shows a photograph of this system with a viscosity of 20 DIN seconds (run-out time in a DIN 4 mm cup), into which 1 wt % ACEMATT® TS 100 was directly stirred for 10 min at 7.3 m/sec.

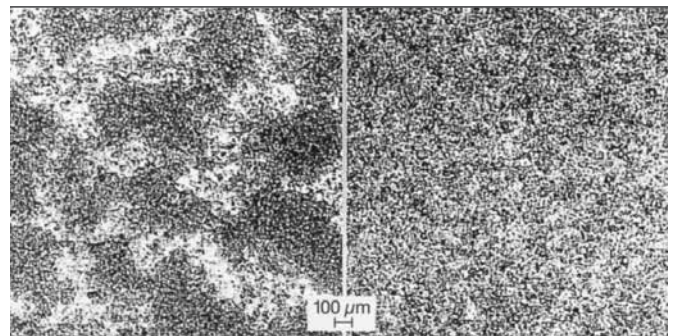


Figure 28

Left side: Direct incorporation

Right side: Incorporation as a preparation

The photograph shows that the matting agent was not homogeneously distributed. However, if a concentrate with 6 wt. % ACEMATT® TS 100 is prepared (viscosity 120 DIN seconds) and is subsequently diluted to a concentration of 1 wt % (20 DIN seconds), the image reproduced in the right half of Figure 28 shows a homogeneous distribution.

The advantage of this method, which is called the master batch process, is obvious for this application. Although many parameters influence the precise determination of the optimum grinding base or dispersant composition, numerous processes are described in the literature [22–25].

7.2 Measuring instruments and geometries for reflectometer measurement

For many years, various manufacturers have offered gloss measuring instruments, which are both designed and tested according to DIN. The traceability of the gloss standards to the standards of the Federal Institute for Materials Research and Testing in Germany (BAM) is guaranteed. If the proper instruments are used, the objective gloss measurement is independent of instrument type or location of use.

The quantitative analysis of the degree of matting of coating film surfaces as a function of the selected angle of measurement is described in the literature [10, 11, 19, 30, 31], DIN EN ISO 2813. These standards prescribe the use of 20° measuring geometry when the 60°-reflectometer value is greater than 70 and recommend the 85° measuring angle when the 60°-reflectometer value is less than 10.

As we see in Figure 29 a, b, c, the 20° measuring angle differentiates best in the high-gloss range, while the 85° measuring angle differentiates more effectively in the matt range. The 60° angle is used in the range between high gloss and matt and must be considered the standard angle for the measurement of matt coating film surfaces.

Figure 30 shows the functional relationship between the 85°-reflectometer value and the average agglomerate particle size d_{50} determined by the laser diffraction method using various ACEMATT® grades. The 60°-reflectometer value is constant at 20 in all cases.

The difference between the 85°-reflectometer value and the 60°-reflectometer value, often denoted as sheen, provides information on the particle size distribution resulting in the dried film at comparable 60°-reflectometer values. It follows from the figure that the extremely finely divided ACEMATT® OK 607 is preferable for matting coatings that are intended to have a high sheen as a function of the observation angle. If it is important to have essentially the same degrees of matting at different angles of observation, the use of coarser products such as ACEMATT® HK 440, ACEMATT® HK 450, ACEMATT® 810 or ACEMATT® TS 100, is recommended.

Figure 29a
Gloss measurement on an alkyd-melamine baking enamel at the 20° angle of measurement.

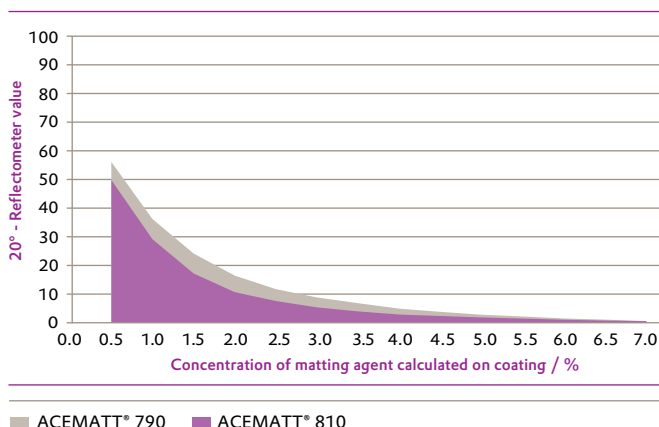


Figure 29b
Gloss measurement on an alkyd-melamine baking enamel at the 60° angle of measurement.

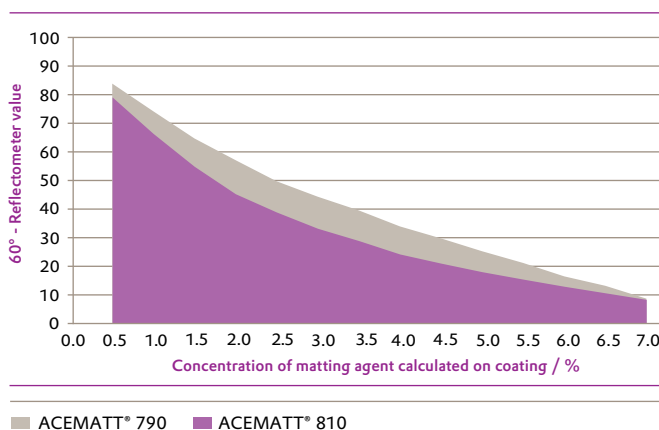


Figure 29c
Gloss measurement on an alkyd-melamine baking enamel at the 85° angle of measurement.

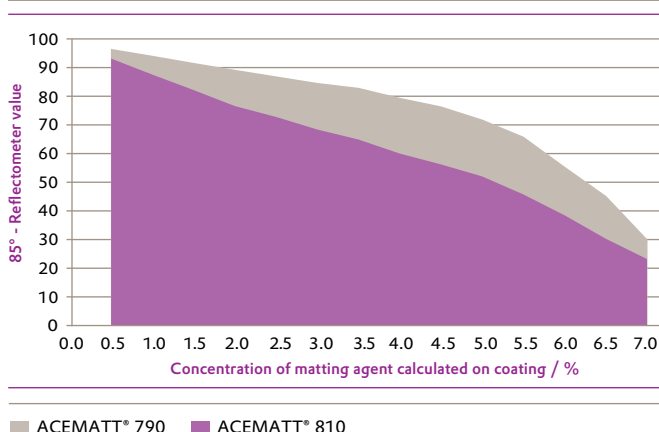
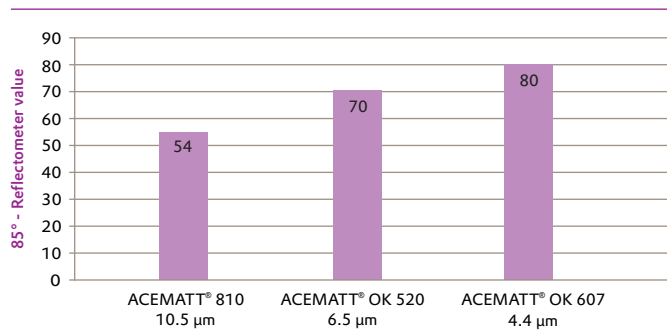


Figure 30

Influence of average agglomerate particle size d_{50} (laser diffraction method) on the 85°-reflectometer value of matted baking enamels at same 60°-reflectometer values of 20.



7.3 Rheological behaviour

The influence on the rheological properties of the coating by precipitated silica of the ACEMATT® product line is very small, whereas thermal silica frequently lends a certain thixotropy to the various systems. This effect is desired in many applications. The addition of thickeners or thixotropizing agents is therefore not necessary. This thixotropizing effect prevents the coating from penetrating too much when very absorbent substrates, e. g., wood with large pores, are coated. When matting agents of the ACEMATT® OK type are used, the addition of AEROSIL® 200 or AEROSIL® R 972 may be needed, as illustrated in Figure 31.

**Figure 31**

Alkyd resin coatings matted with ACEMATT® OK 412.

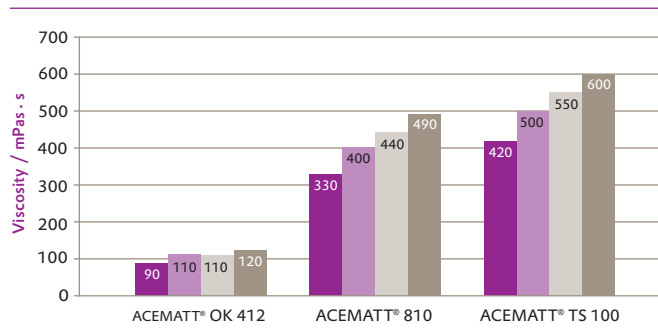
On the **left side** we see white pores caused by considerable penetration of the binder, while the **right side**, with 0.5% AEROSIL® R 972 added, shows an acceptable surface.

The right half of the figure shows an acceptable film surface, while the left half shows light spots due to heavy penetration of the binder solution. These spots are matting agent particles, which, unlike the binder, cannot penetrate the substrate.

Coatings in which the Evonik ACEMATT® products have been incorporated show good long-term viscosity behaviour, as illustrated in Figure 32.

Figure 32

Viscosity of matted PU coatings as a function of the storage time at room temperature.



■ Control ■ Storage time 2 weeks
 ■ Storage time 4 weeks ■ Storage time 6 weeks

7.4 Suspension behaviour in the liquid coating

ACEMATT® 3300, ACEMATT® 3600, as well as all OK types of the ACEMATT® range show good suspension performance even with low-viscosity coatings. The addition of special wetting agents or similar substances is not necessary. This good suspension behaviour is attribute to the organic surface-treatment of the silica surface.

Neither the ACEMATT® HK grades nor ACEMATT® TS 100 are post-treated, unlike the above-mentioned ACEMATT® OK grades. As untreated silica, these matting agents demonstrate a less favorable suspension behaviour. As we can see in Figure 33, this behaviour changes considerably when adding hydrophobic AEROSIL® R 972 [32].

**Figure 33**

Left: Sedimentation of ACEMATT® TS 100 in a wood coating after 8 weeks of storage at room temperature.

Right: Same system, into which 10 wt % AEROSIL® R 972 (calculated on the weight of ACEMATT® TS 100) was stirred before storage. There is no sedimentation of silica.

7.5 Transparency and coloristic properties

Matting, transparency and color are essentially directly correlated. That is, as matting increases, transparency and jetness decreases and colored undertone changes to more bluish. In the case of achromatic black, jetness undergoes the greatest change. Deep color tones are additionally influenced in their chromaticity. This holds true regardless of whether the matting agent is directly incorporated in the pigmented coating or in a unpigmented top coat.

When the matting agent is directly incorporated into the black coating, different matting agents show a similar behaviour. In the matted clear coating applied to a black background, however, differences are noted. This difference in behaviour is observed, for example, in a black baking enamel. **Figure 34** shows ACEMATT® TS 100 and ACEMATT® OK 412 with direct incorporation.

Figure 34 illustrates the different influences of the two ACEMATT® grades on jetness when incorporated in a matt top coat. In both figures, the blackness value M_y is represented as a function of the reflectometer value [33].

Figure 35 shows the superiority of ACEMATT® TS 100. For both examples, the same alkyd/melamine resin-based binder system is used. The differences exhibited in this coating system are applicable to others as well.

Figure 34
Relationship between gloss and jetness with direct incorporation of matting agents in a black coating.

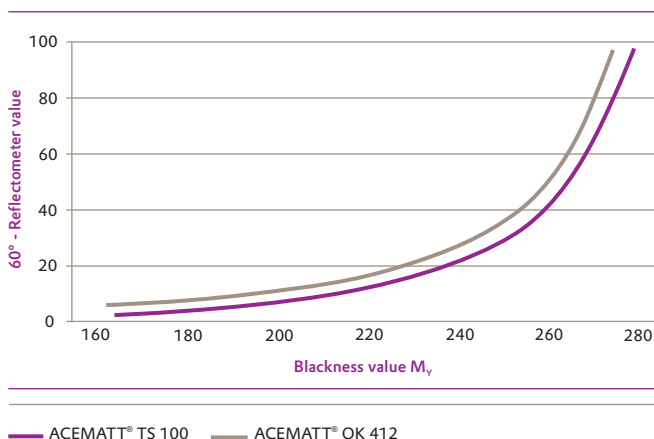
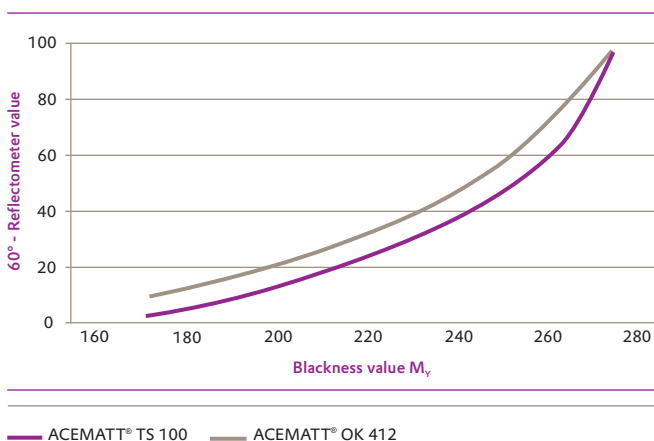


Figure 35
Relationship between gloss and jetness in a top coat of a matted clear coating on a black background.



7.6 Surface roughness

In Section 5.2, we discussed the influence of surface roughness on the achievable degree of matting. With the right equipment, we can determine roughness parameters and surface profiles visualized. Such a device [34] is shown in **Figure 36**.



Figure 36 Hommeltester T 8000

Table 6 shows the values of two different roughness parameters and reflectometer values determined on four matted alkyd/melamine baking enamels. The average peak-to-valley height R_a according to DIN EN ISO 4287-1 is the arithmetic average of the profile deviations from the center line within the measured area. The average total roughness depth R_z according to DIN EN ISO 4287-1 is the arithmetic average of the individual total roughness depths of 5 consecutive individual measured sections within the entire measured section. Both parameters are determined on the roughness profile. The relationship between the degree of matting and roughness is clearly visible.

Table 6

Numerical comparison of average peak-to-valley heights and average total roughness depth (as a measure of surface roughness) and the corresponding reflectometer values of topographical profile images shown in **Figure 37**.

Matt Coating		ACEMATT®			
		HK 450	OK 607	HK 450	OK 607
		A	B	C	D
Matting agent quantity (on coating)	%	2.1	3.8	4.2	5.8
60°-reflectometer value		39.2	38.5	20.4	21.2
85°-reflectometer value		73.0	89.0	54.2	79.8
Average peak-to-valley height R_a	μm	0.27	0.13	0.41	0.20
Total roughness depth R_z	μm	2.25	1.04	3.46	1.63

Figure 37 shows SEM photographs of two coatings which are labeled A and B in the diagram of **Figure 38** and **Table 6**. These images optically confirm the findings obtained from the measured surface roughness. These measurements in fact provide more information than the measured degree of gloss can express.

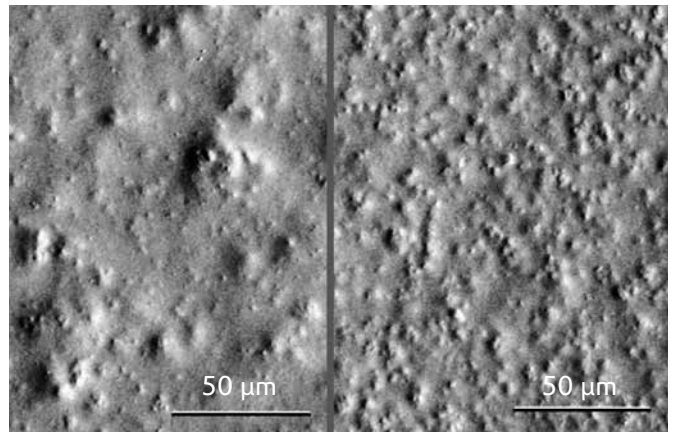


Figure 37

SEM photographs of the surfaces of the coatings shown in **Figure 38** and **Table 6** (fields A and B). Also compare the caption of **Figure 38**.

Profile images C and D, which also describe coatings with the same reflectometer value, are suitable for comparison. The uniformity with ACEMATT® OK 607, in Field D, appears higher than in Field C, which was obtained with ACEMATT® HK 450.

Figure 38 (A-D) shows topographic surface representations of four matt coatings adjusted with ACEMATT® HK 450 and ACEMATT® OK 607, in two gloss levels for each case. This figure shows both the uniformity of the roughening and the increase in surface roughness with increasing concentrations of matting agent.

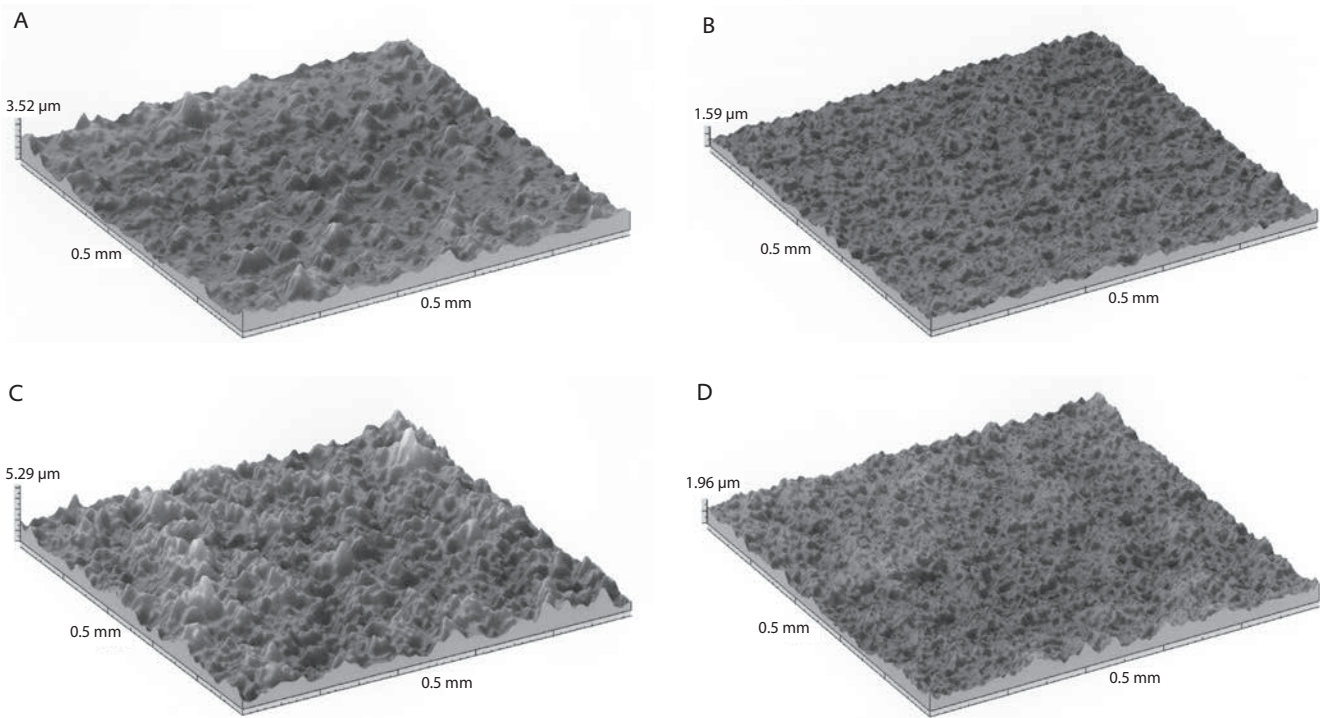


Figure 38

Topographical representations generated by a Hommeltester T 8000 [34].

Left: ACEMATT® HK 450, right: ACEMATT® OK 607. The concentration of matting agents and the measurements are shown in Table 6.

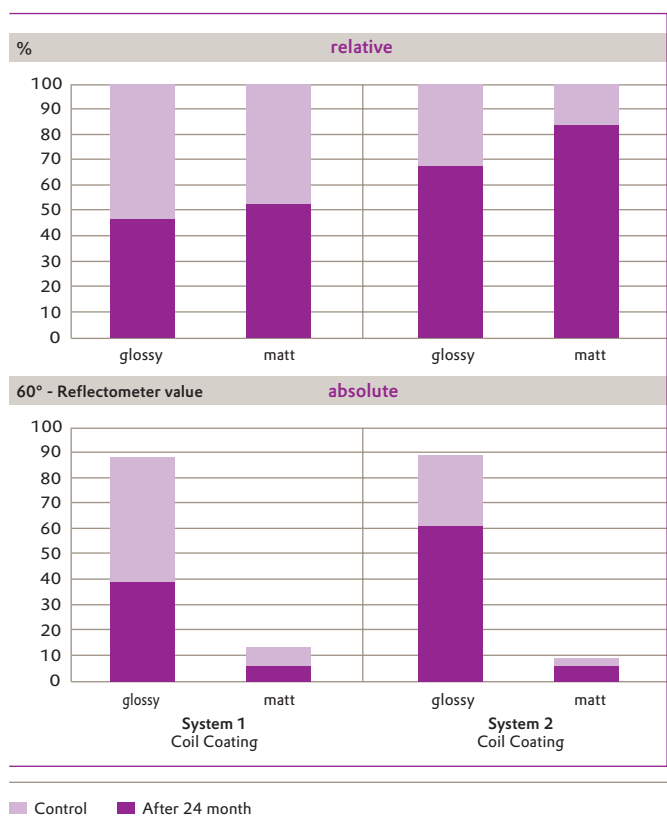
The topographies in Figure 38 optically confirm the findings obtained by measuring surface roughness (Table 6). These measurements actually provide more detail than the measured gloss alone can express. Both profile images A and B and profile images C and D, which describe coatings with the same 60°-reflectometer values, are suitable for comparison.

7.7 Weather resistance

Weathering of coating films causes, in particular, a change of the film surface as a function of time. Depending on weather conditions and on the resistance of the binders, pigments and fillers used and on the pigment volume concentration, there will be more or less degradation of the coating film surface. Differences in the degree of degradation are determined in the field by gloss measurement, for example, at 60°. In the case of matted exterior coatings, the choice of binders is quite important. One example are coil coatings, which have high weather resistance because of the use of selected binders, pigments and matting agents.

Figure 39 compares glossy and matt surfaces after 2 years in the Florida test using two binders ordinarily used for coil coatings. The relative reduction of gloss in both matted coatings is less than in the control systems.

Figure 39 Florida test



8 Product safety



Figure 40
Outdoor weathering station of Evonik at the Wolfgang Industrial Park in Germany.

7.8 Chemical resistance

One of the major requirements of matted wood and furniture coatings is the resistance to household chemicals. This requirement is met by ACEMATT® products with the use of suitable coating systems. ACEMATT® TS 100 provides excellent results even under significant stress.

Figure 41
Chemical resistance of different ACEMATT® products in furniture coatings.

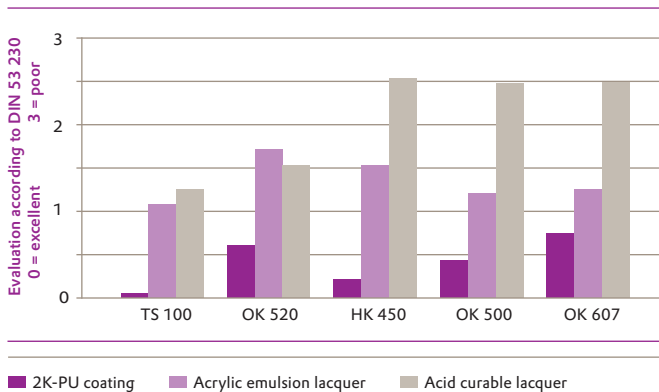


Figure 41 shows the chemical resistance of different coating systems matted with ACEMATT® products. The exposure of the coatings to different household chemicals (purified water, salt water, vinegar, white wine, cleaning solution, shoe polish, cola beverage, salad oil, ketchup), lasted for 24 hrs.

Synthetic amorphous silica and their surface treated variants are free of crystalline constituents. Here, measurement methods include X-ray diffraction, high resolution transmission electron microscopy and electron diffraction. The detection limit for these methods is 0.05 percent by weight. Also, electron-scanning microscopy used in conjunction with electron diffraction makes it possible to identify solid structures up to a size of 0.5 nm (nanometers). Based on the latest findings, ACEMATT® products can be classified as completely amorphous.

8.1 Toxicology

Findings collected over the past decades in the context of manufacturing and processing ACEMATT® products have shown no toxic effects on humans when used as directed.

Acute toxicity of synthetic amorphous silica, rat, oral, LD₅₀, is more than 5,000 mg/kg. ACEMATT® products do not irritate the skin or eyes.

8.2 Information on handling of synthetic amorphous silica

Air venting systems are recommended for facilities that process ACEMATT® products in powder form. If the German OEL* value of 4 mg/m³ (inhalable fraction) is exceeded, a dust mask (P 2 Particle Filter Class) must be worn. Electrostatic charges may build up when handling ACEMATT® products, so that the facilities used must be adequately grounded. To avoid the feeling of dryness that results from contact with bare skin, ACEMATT® products should be washed off using water and exposed skin should be treated with moisturizing cream. Spilled product should be collected with a minimum of dust build-up and collected in adequately sealable containers. ACEMATT® products can be disposed of as per recommendations in the European Waste Catalog.

8.3 Legal classification

Based on currently applicable standards of Chemical Substance Legislation, the Hazardous Substance Advisory and Transportation Regulations, ACEMATT® products are not classified as hazardous substances or dangerous goods.

For further information on product safety or copies of our Safety Data Sheets, please contact:

Evonik Resource Efficiency GmbH
MAIL: sds-hu@evonik.com

8.4 Registration status of ACEMATT®

Table 7
Important classification data

Products	CAS Reg. Nr.	Chemical Name	Europe REACH	USA TSCA	Japan ENCS	Australia AICS	South Korea KECI	Philippines PICCS	Canada DSL	China IECSC
ACEMATT® 82 ACEMATT® HK 125 ACEMATT® HK 400 ACEMATT® HK 440 ACEMATT® HK 450	112926-00-8 resp. 7631-86-9	Silicon dioxide, chemically prepared	registered	registered	registered	registered	registered	registered	registered	registered
ACEMATT® 790 ACEMATT® 810	112926-00-8 resp. 7631-86-9	Silicon dioxide, chemically prepared	registered	registered	registered	registered	registered	registered	registered	registered
ACEMATT® TS 100	112945-52-5 resp. 7631-86-9	Silicon dioxide, chemically prepared	registered	registered	registered	registered	registered	registered	registered	registered
ACEMATT® 3300	112945-52-5 resp. 7631-86-9	Silicon dioxide, chemically prepared / polysiloxanes	registered	registered	registered	registered	registered	registered	registered	registered
ACEMATT® 3600	112926-00-8 resp. 7631-86-9	Silicon dioxide, chemically prepared / siliconepolyetheracrylates	registered	registered	registered	registered	registered	–	registered	registered
ACEMATT® OK 412 ACEMATT® OK 500 ACEMATT® OK 520 ACEMATT® OK 607 ACEMATT® OK 900	112926-00-8 resp. 7631-86-9/ 9002-88-4	Silicon dioxide, chemically prepared / ethene, homopolymer	registered	registered	registered	registered	registered	registered	registered	registered

* Occupational Exposure Limits

9 Logistics and handling

9.1 Packaging and weights

Matting Agents	Packaging	Pallet Weights
ACEMATT® 82	15 kg	240 kg net
ACEMATT® HK 125	15 kg	450 kg net
ACEMATT® HK 400	15 kg	450 kg net
ACEMATT® HK 440	10 kg	300 kg net
ACEMATT® HK 450	10 kg	300 kg net
ACEMATT® 790	10 kg	390 kg net
ACEMATT® 810	15 kg	450 kg net
ACEMATT® 3600	12.5 kg	375 kg net
ACEMATT® OK 412	15 kg	450 kg net
ACEMATT® OK 500	15 kg	450 kg net
ACEMATT® OK 607	15 kg	450 kg net
ACEMATT® OK 520	10 kg	300 kg net
ACEMATT® OK 900	12.5 kg	487.5 kg net
ACEMATT® TS 100	10 kg	180 kg net
ACEMATT® 3300	10 kg	180 kg net

9.2 Storage conditions

ACEMATT® matting agents are substances that, due to their high specific surface, can absorb gaseous foreign substances during transportation and storage, even with high-quality packaging. This includes humidity. Depending on pressure and temperature, equilibrium is reached after some time.

ACEMATT® products should therefore be stored in closed rooms in accordance with the instructions for use, at an appropriately low relative humidity and constant temperature, separated from products with high vapor pressure or substances that release gases.

9.3 Storage time

ACEMATT® products has a high chemical purity and is therefore also for the most part chemically inert. Under normal storage conditions, it will not alter its chemistry—even over a long storage period (approximately 10 years). We do not, however, recommend exceeding a storage time of two years.

9.4 Control number

The control number of ACEMATT® products is a coded fill date and is indicated at the bottom of the bag.

9.5 Handling

All steps in the processing of ACEMATT® products must be designed to ensure the most dust-free possible atmosphere in the operating environment. For additional details, we recommend our brochures series 28 and 62: „Handling of Synthetic Silica and Silicates“ and „Synthetic Silica and Electrostatic Charges“. With regards to handling, our technical support can provide material handling training at our facility. Our staff will gladly support you by answering your questions on conveying, metering and bag emptying and other handling-related topics.

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11 Brief technical glossary

Acrylic resin coatings

Monomers of these film-formers are derivatives of acrylic acid or methacrylic acid and their esters. Coatings of acrylic resins are resistant to mechanical and chemical influences and exhibit excellent light and weather resistance.

Adsorption

The adhesion of the molecules, ions or atoms of gases, dissolved substances, or liquids in more or less concentrated form to the surfaces of solids or liquids with which they are in contact—a concentration of a substance at a surface or interface of another substance (DIN 28400).

Agglomerates

Collection of weakly or medium strongly bound particles where the resulting external surface area is similar to the sum of the surface areas of the individual components (ISO 26824)

Aggregate

Particle comprising strongly bonded or fused particles where the resulting external surface area is significantly smaller than the sum of surface areas of the individual components (ISO 26824)

Alkyd/melamine resin systems

Coating mixtures of both basic components. This system combines the hardness (and brittleness) of melamine resins with the elasticity of alkyd resins.

Alkyd resin coatings

The components of these resins belong to the substance class of polyesters. Polyesters are the product of polyesterification (reaction between organic acids and alcohols) of bivalent or polyvalent alcohols with dibasic or polyvalent organic acids. Characteristic of the alkyd resin skeleton are inserted trifunctional or polyfunctional alcohols and fatty acids such as oleic acid, palmitic acid, stearic acid, linoleic acid, etc.

Arithmetic mean roughness value Ra

According to DIN EN ISO 4287, Ra is the arithmetic mean of the sum of roughness profile values.

Association

Combination of several identical molecules into large complexes without the formation of true chemical bonds.

ASTM

Abbreviation for American Society for Testing and Materials. Comparable to → DIN.

Attrition process

→ Dispersion.

Average total roughness depth Rz

According to DIN EN ISO 4287, Rz is determined as the sum of the roughness profile derived from the height of the highest peak Rp and the lowest valley Rv within a single measuring lengths.

Baking enamels

Coating materials that are dried at higher temperatures and/or crosslinked by heat action.

Binder

Non-volatile portion of a coating material with → pigments and → fillers. The binder joins the pigment particles together and to the substrate, thereby forming, together with them, the finished coating DIN EN ISO 4618.

Blackness value M_v

According to EN DIN 55 979, is the jetness value $M_v = 100 (2 - \log Y)$ or $100 D_{visr}$ which is perceived following the visual impression and is measurable only as a function of brightness.

CAS Reg. Number

Chemical Abstracts Service Registry Number. Number under which a chemical substance is catalogued in Chemical Abstracts.

CC enamels

Coil coating enamels = continuous coating of steel strip

Chromaticity

Difference between a → color and the achromatic of the same brightness (DIN 5033). "Chroma" corresponds, with many of its properties, to the usual term "purity" or "brilliance" used by colorists.

Color

Sensation imparted by the eye according to DIN 5033. A color is characterized by color shade, saturation and brightness.

Convection

The transport of energy or electric charge by the smallest particles of a flow.

Degree of mattness

Expressed by → gloss measurement.

Diffusion

Chemical mutual penetration of gases or liquids.

DIN

Deutsches Institut für Normung e.V.
→ German Institute for Standardization.

DIN seconds

According to DIN EN ISO 2431, unit for the efflux time of a liquid.

Dispersibility

According to DIN 53206-1, ability of a powdered material to be dispersed. Depends on the wettability of the substance and on the number and strength of the points of adhesion between the components of the → agglomerates.

Dispersing processes

Include high-speed stirrers, bead mills or ball mills, disk-type ink grinders and oscillating shakers according to DIN EN ISO 8780-1.

Dispersion

General name for a colloidal system, particularly for finely divided solids in a liquid.

Drying loss

Weight loss of materials determined according to ISO 787-2 (2 hrs of drying at 105 °C in the drying oven).

Enamel (enamel system)

According to DIN 55945, blanket term for a multiplicity of coating substances based on organic film formers. The enamel system can refer, for example, to the type of binder.

Electrostatic charges

Occurrence of electric charges on contact between two solid substances with a different electron affinity, particularly in motion processes.

Florida weathering

Weather resistance test in a tropical climate.

Fumed silica

An exceptionally pure form of silicon dioxide made by reacting silicon tetrachloride in an oxy-hydrogen flame. Used to impart thixotropy to liquid resins and in dry molding powders to make them free flowing. Also referred to as pyrogenic or thermal silica. → Pyrogenic silica → Thermal silica.

Gloss

According to DIN EN ISO 4618, human perception of the more-or-less directed reflection of light rays on a surface.

Gloss measurement

According to DIN EN ISO 2813, process for numerical determination of the perception of gloss. Based on 20° measuring geometry when 60° value > 70, based on 85° measuring geometry when 60° value < 10, based on 60° measuring geometry when value is between 10–70.

Grinding stability

Here, hardness of the matting agent against mechanical (grinding) stress such as that occurring in the processing of enamels or matting agents. If the stress is too high (long grinding or dispersing times, intensive grinding), the matting action of a silica can be impaired. We then say the matting agent suffered over-grinding!

Grindometer value

According to DIN EN ISO 1524, used to evaluate the grain size of coating materials and other pigment-binder systems.

Hydrophobicity

Property of a hydrophobic substance, i. e. can not be wetted with water.

Ignition loss

According to DIN EN 3262-1, is the term for the weight difference between dry weight and weight of the ignition residue. Expressed in %.

Industrial hygiene

Hygienics, health care, preventive medicine in the working world.

Lethal dose

Term from the field of toxicology. Dose determined in an animal experiment that results in death within a certain time. The dose at which 50% of the animals of a group are killed is called LD₅₀.

Master batch process

→ mill base composition.

Mill base composition

Concentrate coordinated with the dispersing equipment used, consisting of → pigment → binder, solvent and any additive used.

NC combination coatings

Coatings consisting of nitrocellulose, alkyd resin, plasticizer and other film formers.

Oven-drying enamels

→ baking enamels.

Pigment

According to DIN EN ISO 4618, is an organic or inorganic, chromatic or achromatic colorant that is insoluble in solvents.

Polyurethane enamels

Usually two-component enamels containing a polyol component and an isocyanate component as characteristic film formers.

Profile coordinates

Blanket term for the description of the → surface roughness according to different criteria.

Primary particles

According to ISO 26824, original source particle of agglomerates or aggregates or mixtures of the two.

Pyrogenic silica

→ Fumed silica

Reflectometer value

According to DIN EN ISO 2813, the characteristic describing the → gloss of a surface.

Refractive index

Determined according to DIN EN ISO 6320 for light with a wavelength of 589.6 nm, relative to vacuum, and denoted as n_D .

Roughening

Roughness of a surface → average peak-to-valley height
→ average surface roughness.

Roughness

→ surface roughness.

Segregation

In this case, separation of the matting agent particles from the liquid coating material.

Skandex

Oscillating shaker according to DIN EN ISO 8780-2.

Solid content

According to DIN EN ISO 4618 proportion by weight of a substance that persists after removal of the volatile fractions under established test conditions.

Surface coatings

Liquid or powdered products that form, on a substrate, a covering film having protective, decorative or specific technical properties (DIN EN ISO 4618).

Surface roughness

→ roughening.

Surface treatment

Here, the modification of the surface of highly disperse substances such as silica. The surface treatment results in modified reactivity of the surface (e.g., blockade of reactive groups) or the wetting property and hence in a change in the coating performance.

Suspension behaviour

Here, the property of the matting agent in the coating. A good suspension behaviour implies no formation of a solid sediment. The OK grades of our ACEMATT® family generally show good to very good suspension behaviour.

Tapped density

According to DIN EN ISO 787-11, the ratio of mass to volume of a substance after tapping.

TEM photograph

Transmission electron microscope photograph.

Thermal silica

Synthetic, highly dispersible silica manufactured using high-temperature hydrolysis. (Also referred to as pyrogenic silica. → Pyrogenic silica → Fumed silica).

Two-component system

Because the two components begin to react immediately when combined, they must be kept separate. They are mixed together only just before the coating is applied. The chemical cross-linking reaction then occurs between the two components. The ratio of the two reactants must therefore be determined according to stoichiometric conditions. In the case of 2K-PU systems, approximately one hydroxyl group must be available as a reactant for each isocyanate group.

Water-based coatings

Also called water-soluble coatings. Coating systems containing primarily water instead of organic solvent as a solvent component. Water-based coatings are generally more ecofriendly than conventional coating systems.

Weather resistance

Resistance of coating systems to climatic exposure and weather influences. Parameters affecting this are humidity (moisture), heat, cold and solar (UV) radiation.

Wetting

Process in which the solid (pigment) -air interface is replaced by a solid-liquid interface.

X-ray amorphous

Said of substances that, in an x-ray examination, reveal no reflections, i. e. do not have an ordered structure.

Opposite: crystalline substances.

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