



ADVANCED MATERIALS

**Pergopak® Organic
Matting and Effect Agents:**
For the Coating and
Ink Industries



Pergopak® 

MATting AGent AND CARRIER



Pergopak® Organic Matting & Effect Agents: An Introduction

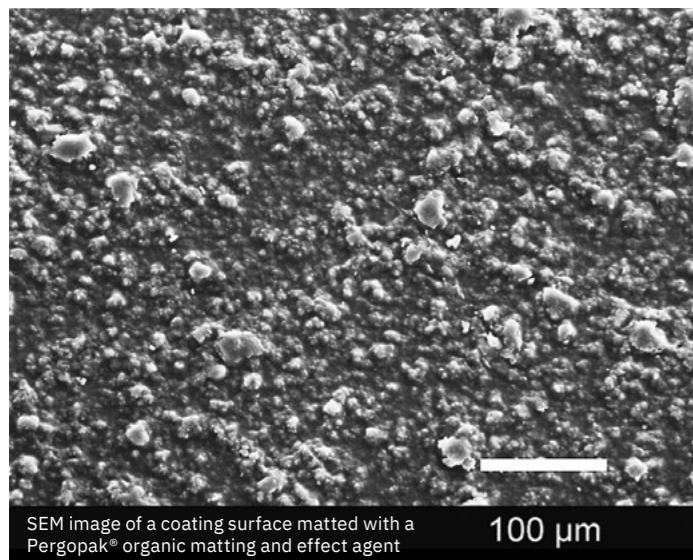
Pergopak® matting and effect agents are organic thermoset polymethyl urea resins (PMU) that achieve a high performing balance of matting, transparency, rheology control and abrasion resistance along with a soft-feel. They allow the creation of surface properties and visual and physical effects, which cannot be achieved by standard matting agents like silicas or waxes by themselves. Due to their chemical nature and structure, Pergopak® products can be used alone or in combination with other matting agents in a variety of coating formulations.

There are four Pergopak® grades which provide a high performing balance of matting, clarity, rheology and abrasion resistance along with a pleasant feel. As thermoset polymers, Pergopak® products provide advantages in the overall resistance of the coating due to its hardness and non-melting properties.

Key Features of Pergopak®

High chemical purity
Narrow particle size distribution

- Primary particle sizes 0.1 – 0.5 microns
- D50 ranges: 3.5 – 10 microns
- High specific surface areas: 14 – 22 m²/g



SEM image of a coating surface matted with a Pergopak® organic matting and effect agent

100 μm

Why Pergopak®?

When silica and wax matting agents do not offer the performance properties you require, Pergopak® products can provide the ideal solution:

Gloss reduction of coatings and paints identified as an ongoing trend

- Broad use in almost any kind of coating

Easy incorporation of matting and effect agents at any stage of formulating paints and coatings

- Complexity reduction of processes – less production steps (positive effect on sustainability)

Limited to no influence on rheological profile

- Very good processability of coatings

Improvement of durability (positive effect on sustainability)

- Improvement of weathering resistance
- Improvement of mechanical and chemical resistance

Complexity reduction of coating formulations

- Less additives needed to achieve desired performance

Performance Comparison of Matting Agent Technologies

Key performance requirements of matting agents in coatings and inks and how most prominent matting agent technologies compare

- Pergopak®
- Silica
- Wax



Physical Properties

- Pergopak® is a voluminous powder of low bulk density.
- Product grades have an excellent degree of whiteness.
- Primary particles, with an average particle diameter of 0.1 – 0.15 µm, form nearly spherical agglomerates of 3 – 9 µm.
- These agglomerates have a relatively high specific surface area and pore volume.
- Pergopak® matting and effect agents are more easily incorporated into coatings compared with silicas.
- The spherical structure and the lack of silanol groups contribute to lower viscosity when compared to silica. The particles are very stable and high shear energy does not cause the agglomerates to disperse into the primary particle. Therefore, matting is not diminished as a function of mixing time or processing.
- Pergopak® is organic and leaves no residue upon burning (security paper).

Physical Properties

Density:	1.47 g/cc
Bulk Density:	80 g/m ²
Decomposition Temperature:	> 220 °C
Oil Absorption:	310 ml/100 g
Specific Surface (BET):	14 – 22 m ² /g

Product

Product	d50 (µm)	d90 (µm)
Pergopak® M3	6 – 8.5	15 – 19
Pergopak® M4	5 – 7	12 – 15.5
Pergopak® M5	3.5 – 6	9 – 12.5
Pergopak® M6	4	8

Primary applications for Pergopak® matting & effect agents

Application	Pergopak® M3	Pergopak® M4	Pergopak® M5	Pergopak® M6	Matting Agent Requirements
Coatings					
Plastic	■	■	■	■	Transparency, Finish, Haptics
Glass	■	■	■	■	Mechanical and Chemical Resistance
Flooring	■	■	■	■	Mechanical and Chemical Resistance, Non-Slip, Longevity
Leather	■	■	■	■	Transparency, Finish, Haptics
Can Coating	■	■	■	■	Chemical and Mechanical Resistance, No Effect on Rheology
Coil Coating	■	■	■	■	Efficiency and Mechanical Resistance, No Effect on Rheology
Wood, Clear	■	■	■	■	Chemical and Mechanical Resistance, Finish, Transparency
Wood, Pigmented	■	■	■	■	Chemical and Mechanical Resistance, Finish, Transparency
Industrial	■	■	■	■	Efficiency, Mechanical Resistance, Finish
Automotive	■	■	■	■	Finish, Efficiency and Polishing, Chemical and Mechanical Resistance
Printing Inks					
Flexo OPV	■	■	■	■	No Effect on Rheology, Transparency and Efficiency
Gravure OPV	■	■	■	■	No Effect on Rheology, Transparency and Efficiency
Offset OPV	■	■	■	■	No Effect on Rheology, Transparency, Efficiency and Finish
Screen Printing	■	■	■	■	Efficiency, Blocking Resistance
UV Coatings & Inks					
UV	■	■	■	■	No Effect on Rheology, Transparency, Efficiency and Finish

Very Suitable for Application = ■

Suitable for Application = ■

Key Requirements of matting and effect agents

Gloss reduction is a continuous trend in the paint and coatings industry



Rheology & Incorporation

Pergopak® matting and effect agents are easy to incorporate at any stage of the formulation process with limited to no effect on the rheological properties of the coating or ink.

Gloss reduction in almost every application

Pergopak® imparts matting while maintaining high transparency of paint and coatings.

Improves chemical & mechanical resistance

Pergopak® gives a soft-feel to coatings and offers improved scratch and blocking resistance compared with silica. In addition, it positively affects weathering resistance.

Compatibility with other matting technologies

Pergopak® can be easily combined with different matting technologies to achieve optimal matting performance to enhance other required properties.

Roughness and Sensitivity of Matting

The particle size distribution of matting agents is one of the key elements in determining the degree of matting in the coating. As Pergopak® organic matting and effect agents are available in different particle size distributions, the degree of matting can be directly influenced by the grade chosen.

Below and on the following page, different matting agents are compared as a function of loading level. The particle size range of the different Pergopak® product types and their effect on matting can be directly related to the roughness of the coating surface. The rougher the surface, the more matting effect is achieved. If a high matting effect is desired, a coarse Pergopak® product grade should be used. On the contrary, if very smooth coating surfaces are desired, then the finer Pergopak® product types are recommended. However, it is important to remember that more of the finer Pergopak® types may be needed to achieve the desired matting effect. Formulators may find that combining Pergopak® organic matting agents with other types of

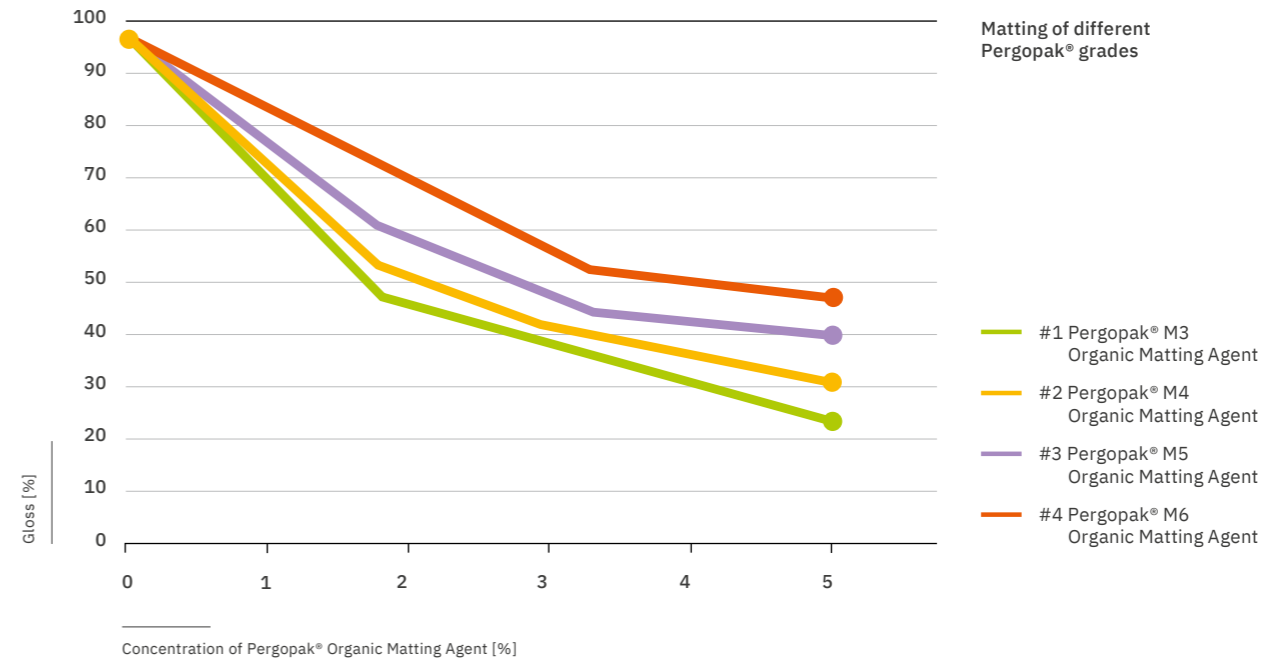
matting agents like silica or waxes may lead to a synergistic effect. However, reduced levels of Pergopak® result in lower abrasion resistance or will impact other properties. Therefore, laboratory tests are always recommended.

Studies with Pergopak® products comparing different solvents in the same coating show that the gloss development of organic matting agents is less sensitive to the solvent choice than coatings containing other matting agent technologies. Varying the drying temperatures or application conditions also shows the same trend.

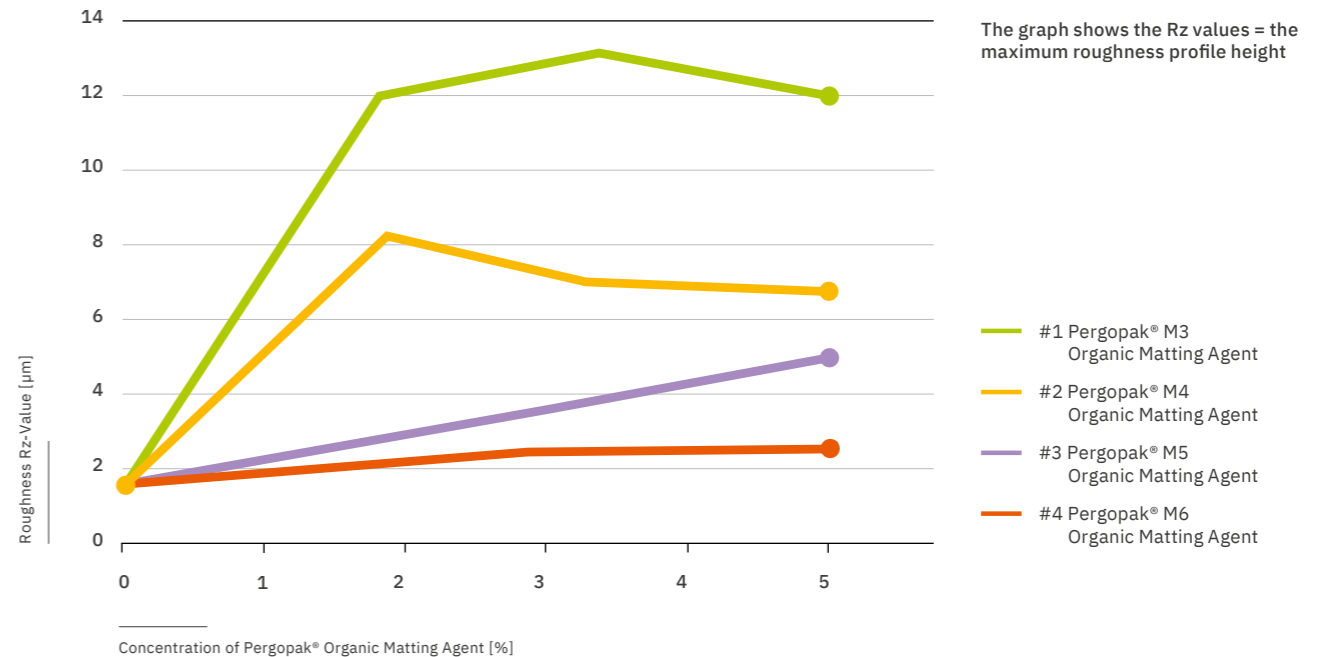
Coatings containing Pergopak® are less sensitive to different applications and formulation conditions, so that the properties of the coating surfaces are more consistent.

Comparison of Coating Gloss and Roughness of the four Pergopak® Product Grades in a Coil Coating: Wet Film Thickness About 25 µm

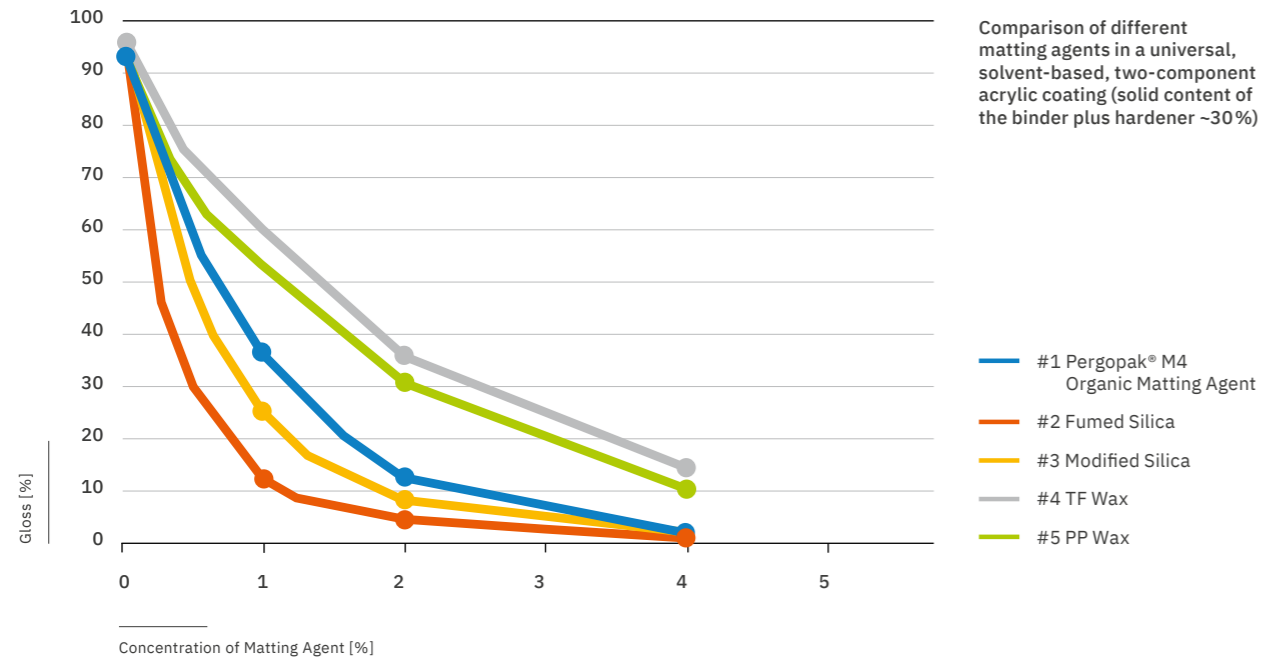
Coating Gloss at 60°



Roughness



Coating Gloss at 60°



Optical Properties

Transparency

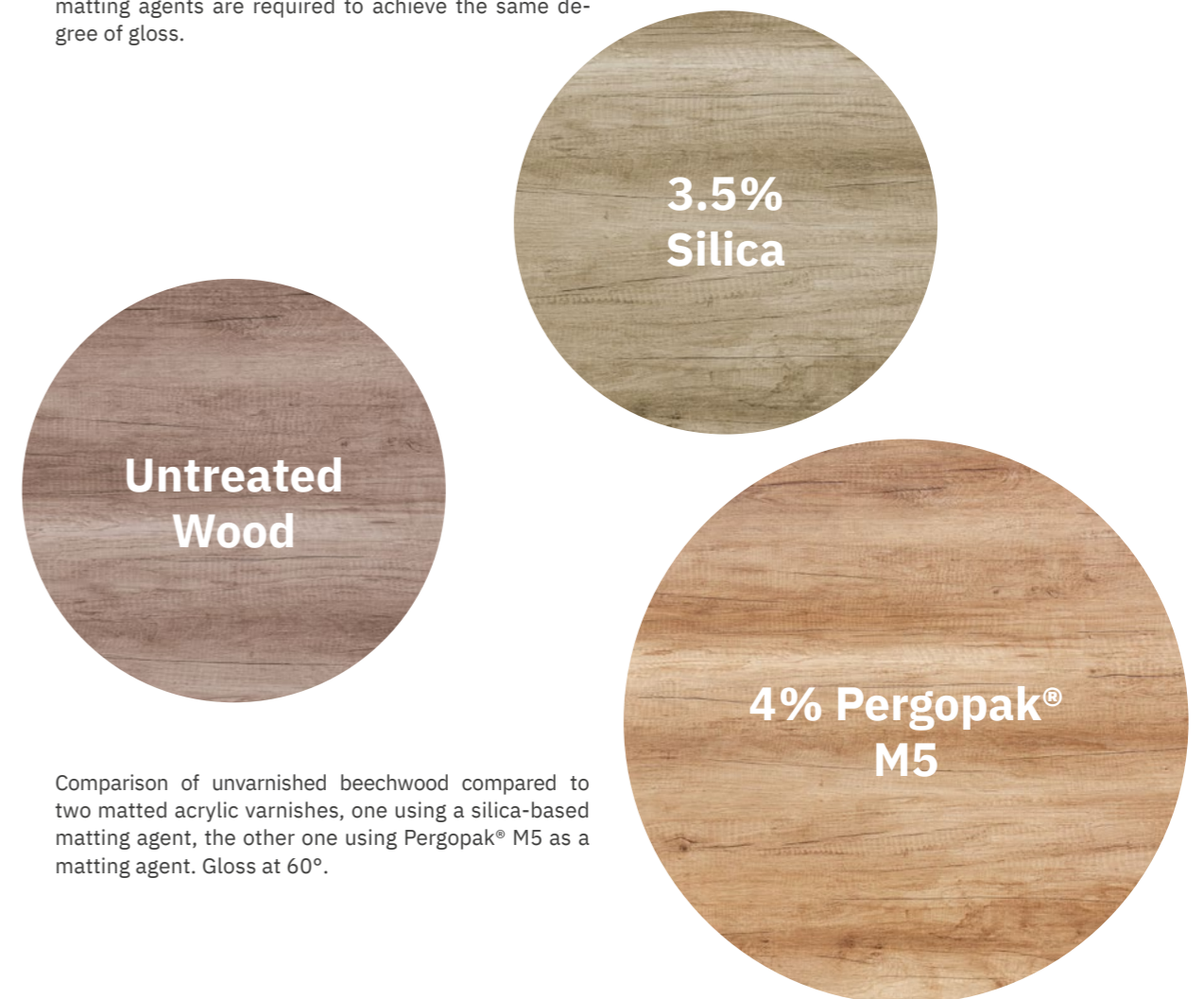
Pergopak® products are almost transparent in many coatings because the refractive index is often very similar to the refractive indices of dried binders. The incorporation of Pergopak® into the wet, unprocessed coating system may lead to a cloudy appearance, but this disappears upon drying.

Even with a high degree of matting, it is still possible with Pergopak® to produce coatings with relatively low film turbidity. This allows formulations with a Pergopak® organic matting agent to help comply with strict requirements concerning little change of color shade. When high levels of Pergopak® are needed to create dull matte systems, the matte effect imparts a cloudy appearance. However, there is still a positive effect on the brilliance of the base shade.



The Desired "Warm-Look"

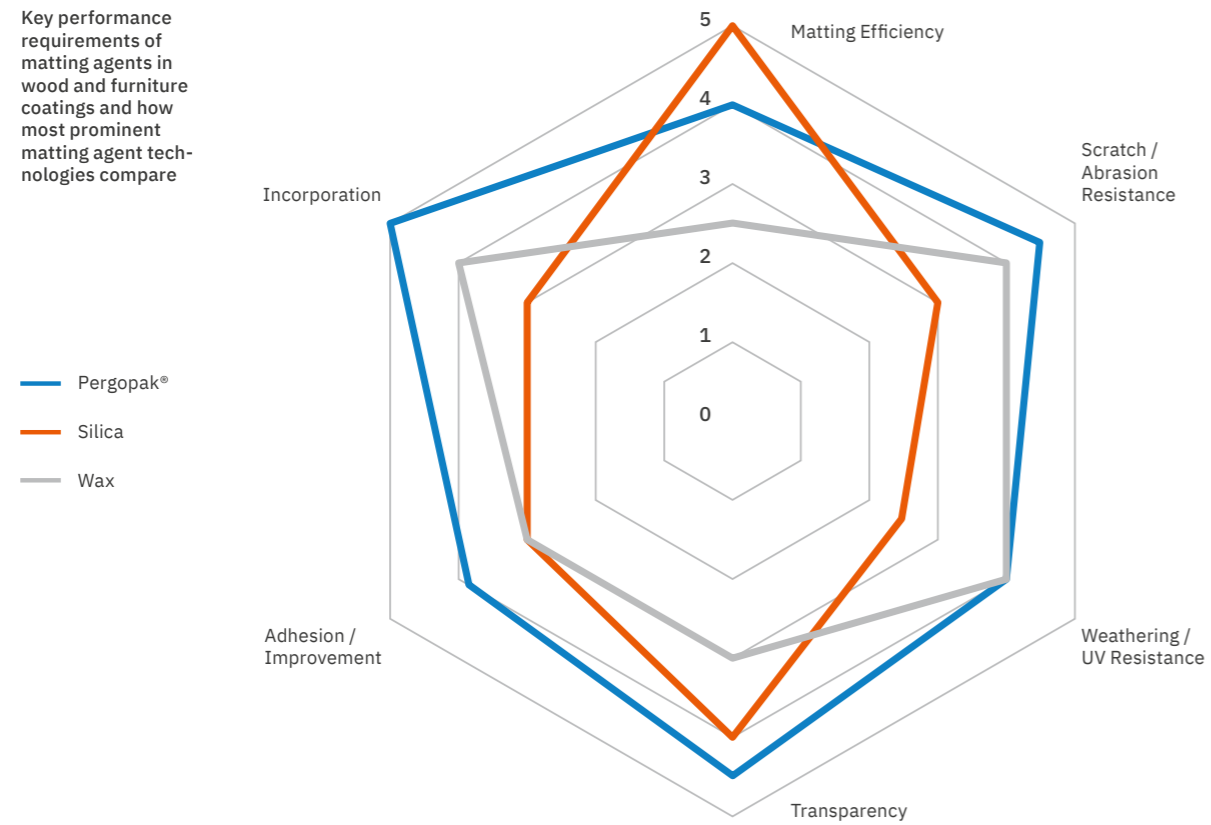
The "warm-look" is desired for wood coatings. Pergopak® helps accentuate the "warm-look" of wood as the organic matting agents have a reduced impact on the optical characteristics when compared to silica matting agents which appear more "synthetic". This is still the case even if higher amounts of organic matting agents are required to achieve the same degree of gloss.



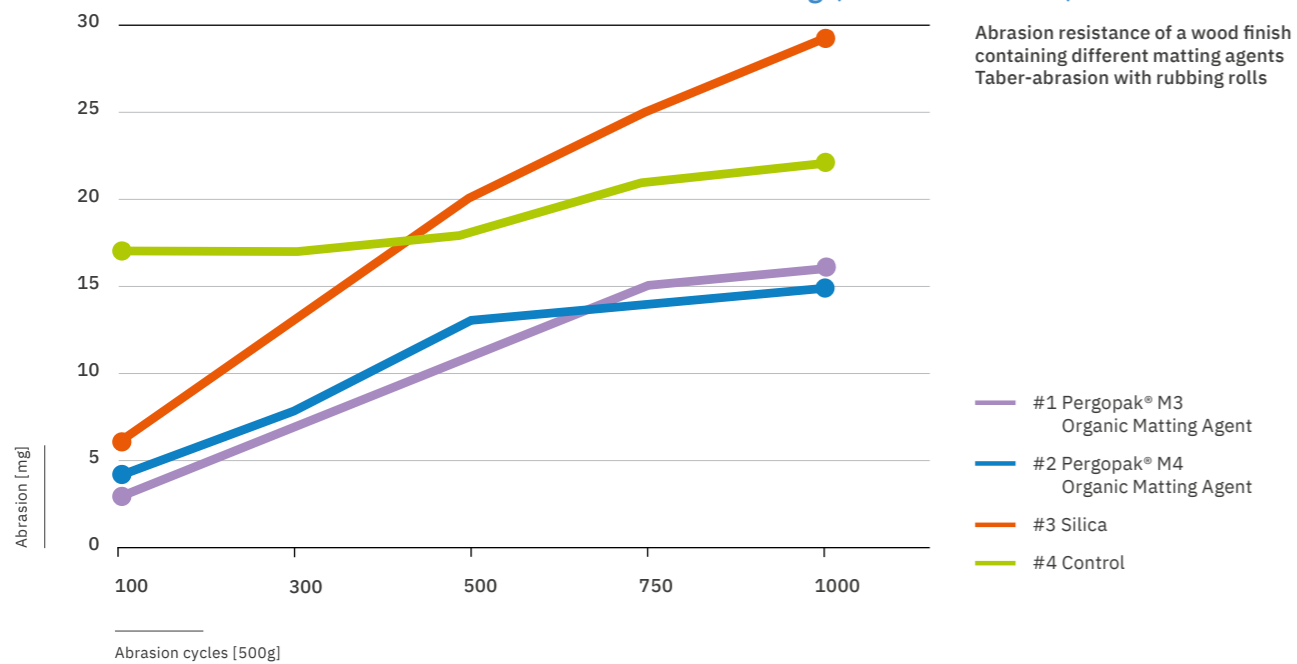
Comparison of unvarnished beechwood compared to two matted acrylic varnishes, one using a silica-based matting agent, the other one using Pergopak® M5 as a matting agent. Gloss at 60°.

Performance of Pergopak® in Wood & Furniture Coatings

Key performance requirements of matting agents in wood and furniture coatings and how most prominent matting agent technologies compare



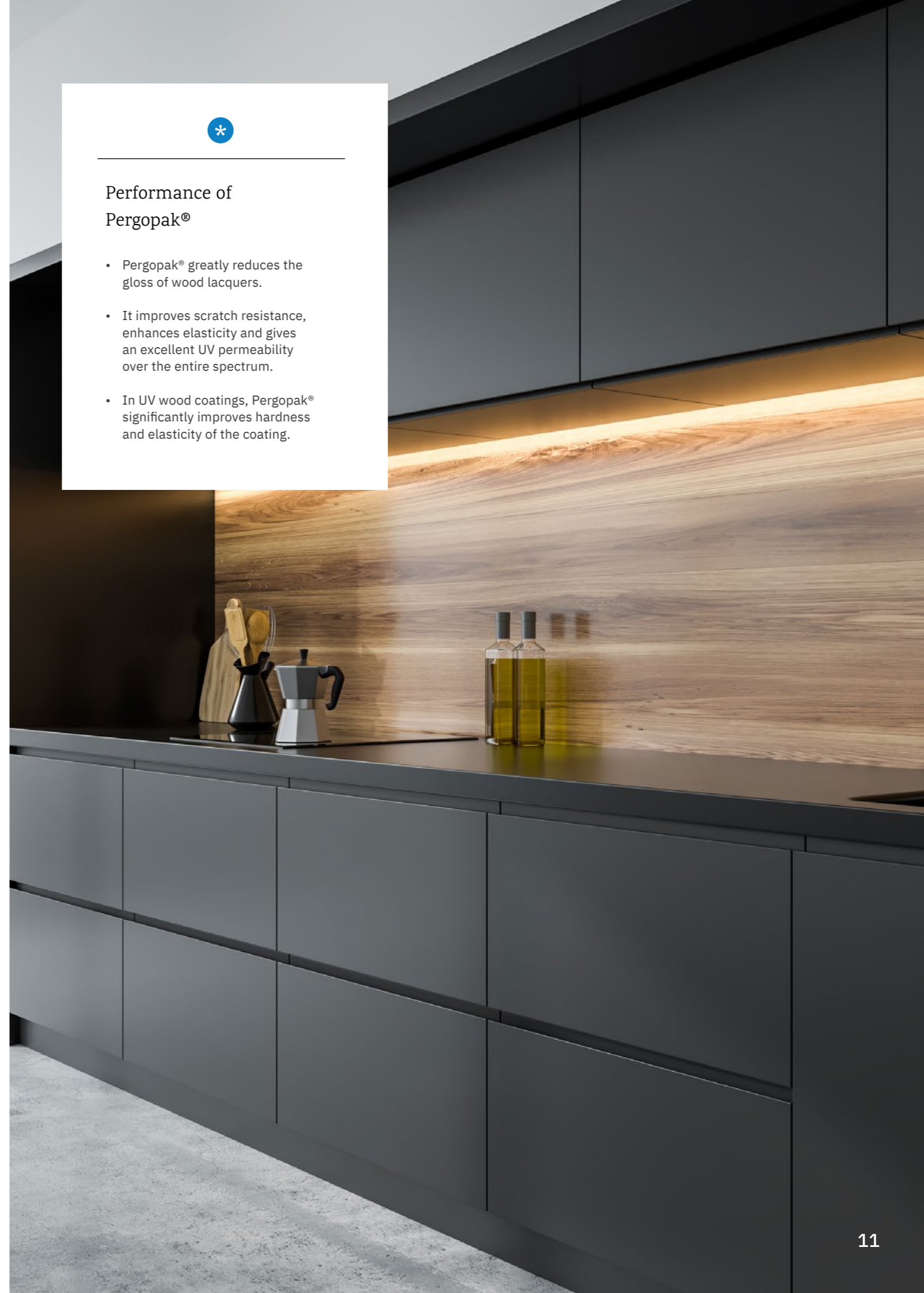
Abrasion Resistance of a 2C-Clear Wood Coating (Taber Abrasion)



Abrasion resistance of a wood finish containing different matting agents
Taber-abrasion with rubbing rolls

Performance of Pergopak®

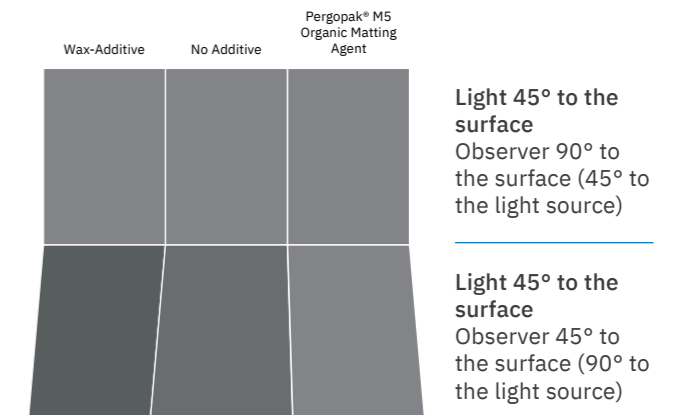
- Pergopak® greatly reduces the gloss of wood lacquers.
- It improves scratch resistance, enhances elasticity and gives an excellent UV permeability over the entire spectrum.
- In UV wood coatings, Pergopak® significantly improves hardness and elasticity of the coating.



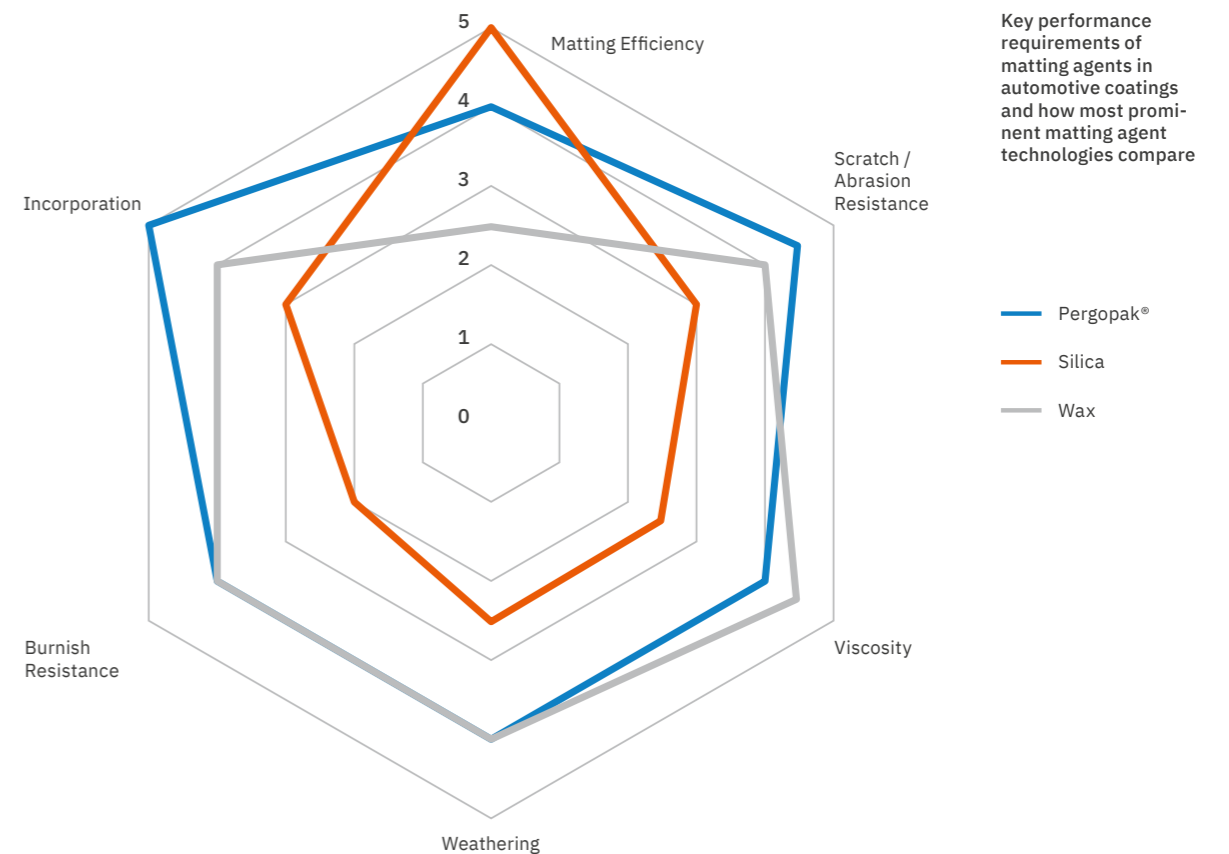


Performance of Pergopak® in Automotive Coatings and Metallic Base Coats

- Pergopak® use in metallic base coats brings several advantages: gloss retention, easy incorporation and high surface smoothness, paired with excellent weather and scratch resistance as well as improved elasticity and substrate adhesion.
- The near-spherical shaped particles of Pergopak® organic matting and effect agents and their narrow particle size distribution influence the flip-flop effect of most metallic effect pigments. In contrast to wax additives that enhance the flip-flop effect, Pergopak® grades will attenuate this effect.



Matting Agent Technologies Comparison



Metallic Effect Coatings

Metallic effect coatings are typically produced with aluminum pigments in the form of flakes or platelets. In addition to the metallic appearance, the characteristic feature of metallic effect coatings is the so-called flip-flop effect. This is the change of brightness observed when the viewing angle is modified. This effect depends on the type of pigments and upon their alignment.

Due to the platelet structure of these effect pigments, they orientate themselves in the medium parallel to the substrate. The near-spherical shaped particles of Pergopak® organic matting and effect agents and their narrow particle size distribution influence the flip-flop effect of most metallic effect pigments. The incorporation of the Pergopak® particles between the metallic pigment platelets leads to defined spatial separation of the pigments in the coating.

In contrast to wax additives that enhance the flip-flop effect, Pergopak® grades will attenuate this effect. The brightness remains constant over a larger angle range and generates a more uniform appearance. With a Pergopak® organic matting agent, metallic effects become adjustable and this provides opportunities to reduce the flip-flop effect when it is not desired.

In applications where the change from dark to light with the viewing angle is distracting, Pergopak® products can be used to reduce the magnitude of this color change. Pergopak® grades generate greater diffuse reflection over a large viewing angle and, thus, allow very different optical properties without suppressing the metallic effect and brilliance. The alignment of the pigments is influenced by the fine Pergopak® product particles that act as spacers between the metallic platelets. Preventing the platelets from tilting helps create a uniform brilliance at different viewing angles.

A combination of Pergopak® with flip-flop enhancing wax additives may suppress a distinct flip-flop effect but this may help achieving the desired visual effect. Laboratory tests are necessary to confirm the optical properties for each specific application.

Viscosity and Rheology

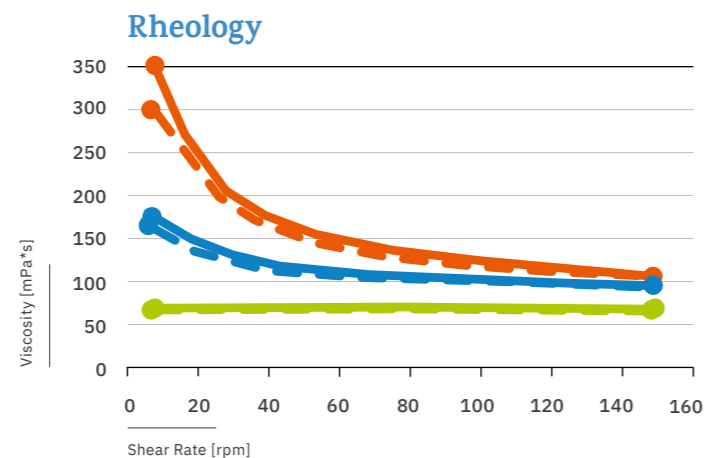
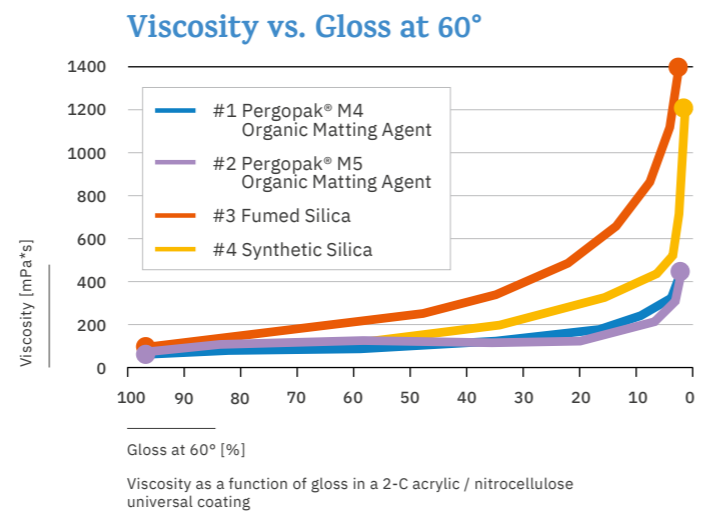
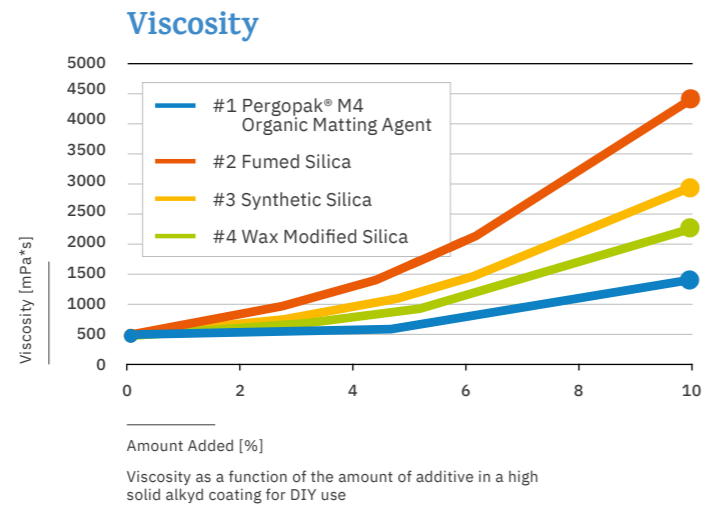
Silicas are efficient matting agents, but when high amounts of silica are required, the viscosity of the coating is often greatly increased. A viscosity increase can lead to application problems.

The advantage of Pergopak® is that significant gloss reduction can be achieved with an increased amount of Pergopak®, but the viscosity is hardly affected. Another benefit is that rheological properties like thixotropy remain unchanged when Pergopak® is used.

Often, formulators opt for a combination of silica with a Pergopak® product, which enables one to optimize the gloss and viscosity values. This leads to more formulation flexibility as the rheological properties are no longer the limiting factor. Coating application methods require a shear-thinning behavior. An ideal rheological behavior is that the viscosity builds up after application, slow enough so that the coating shows good leveling, but also fast enough to prevent dripping or sagging of the coating. These rheological properties demand a significant amount of optimization work by the formulator.

The graphs at right show the viscosity values versus shear rate. The continuous lines of the curve represent the viscosity values with increasing shear rate and the dashed lines represent the values of decreasing shear rate (back). Since the viscosity decreases with increasing shear rate, the coating is considered shear-thinning. Also the samples where the increasing and decreasing shear rate curves do not track exactly on top of one are examples of thixotropic behavior.

- #1 Pergopak® M4 Organic Matting Agent
- - #2 Pergopak® M4 Back
- #3 Fumed Silica
- - #4 Fumed Silica Back
- #5 Base Coating
- - #6 Base Coating Back

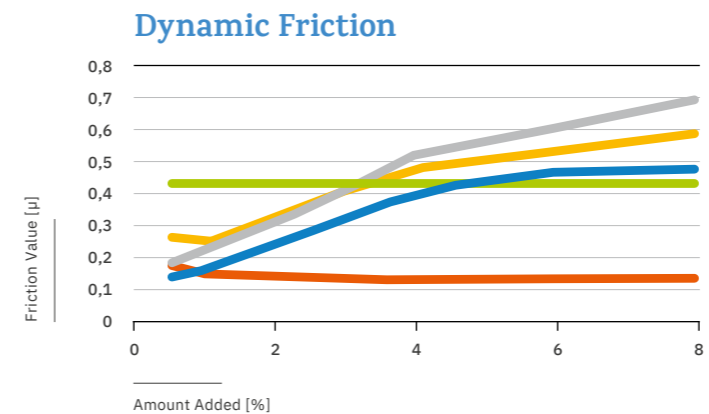
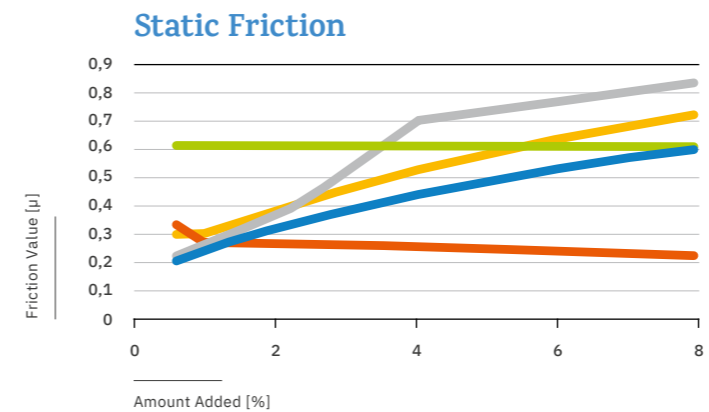


Haptic Properties and Friction

Since Pergopak® matting and effect agents are organic molecules, they impart a significantly softer feel than silica matting agents. This desirable surface feel effect is comparable to surfaces modified with waxes, without adversely affecting recoatability. The near spherical shape of the Pergopak® agglomerates help to produce the velvet soft feel and increases the slip of the surface and reduces friction. Compared to silica,

Pergopak® decreases the static and dynamic friction especially when high levels of matting agents are used.

Explanation of static and dynamic friction: two surfaces will stick together until the sliding force (dynamic friction) is greater than the static friction. This is shown below with a peak of the friction before the sliding starts.





Abrasion and Polishing

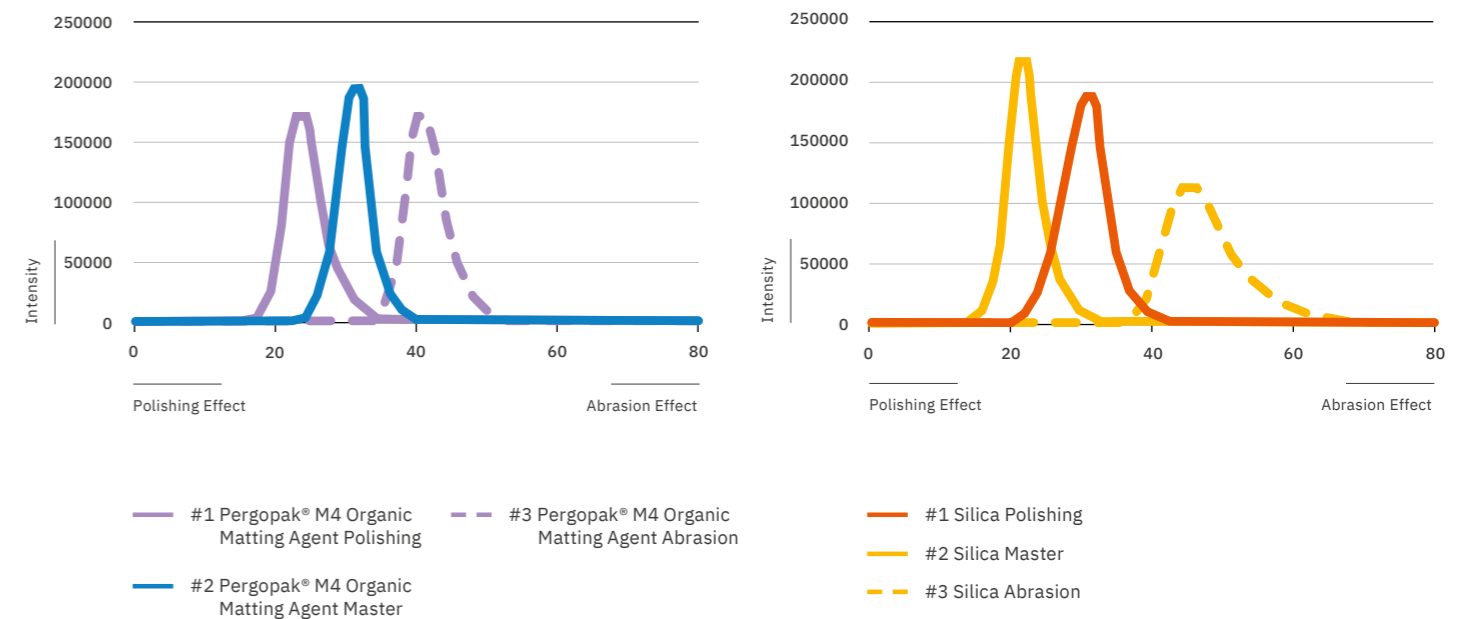
Pergopak® greatly improves Coin-Marking Resistance

Coatings containing Pergopak® are more resistant to abrasion forces than coatings containing silica. This can be explained by very hard, near-spherical agglomerates of Pergopak®. Their presence on the surface of coatings leads to higher mechanical resistance than other conventional matting agents.

brittle or elastic/tough). Organic matting agents are very effectively incorporated into the organic matrix of coatings so that particles are difficult to remove. The near-spherical shape of the agglomerates along with the favorable slip and haptic properties enhances the mechanical resistance. These properties may allow the reduction of surface modification agents.

First, the resistance of Pergopak® particles on the surface must be overcome before the coating matrix can be damaged. Naturally, this effect greatly depends on the properties of the total system. Differences of the resistance of the coating to abrasion or polishing are also influenced by its mechanical properties (hard/

A comparison between the positions of the curves of the treated surfaces and the control surface shows whether polishing or abrasion is occurring. When two different products are compared, then the position of the curves can be compared to distinguish which sample is more or less sensitive to abrasion or polishing. The figures below show that coatings with Pergopak® products are less sensitive than coatings containing silica matting agents.



Soft Feel Coatings

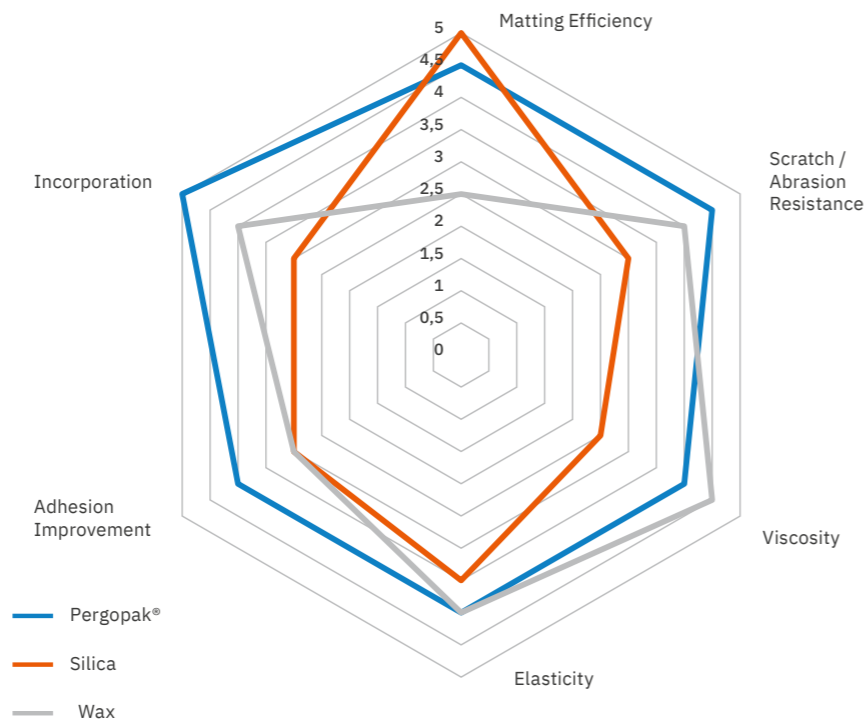
Soft feel coatings give surfaces a pleasant, warm and soft “leather-like” feel. Typically these coatings, such as interior automotive dashboards, have a high degree of matting and demanding requirements for abrasion and scratch resistance. Pergopak® organic matting and effect agents are ideal for use in soft feel coatings when combined with appropriate binders. The narrow particle size distribution and the shape of the particles intensify and promote the soft-feel effect. The special organic structure of a Pergopak® product incorporates readily into the organic matrix, producing highly scratch and abrasion resistant coatings without affecting the elastic properties. The surfaces are smooth and have a vibrant leather-like texture that makes the soft feel effect. The high degree of matting in these coatings may make it necessary to employ

silica in combination with Pergopak®. Laboratory tests must be conducted to find the optimum ratio of organic to inorganic matting agents.

One important consideration is that the mechanical surface properties like scratch resistance and flexibility can be adversely affected by the presence of silica. In principle, the use of waxes is also possible to meet certain coating parameters. However, waxes have a softening point and their reduced temperature resistance may cause coatings to have a reduced resistance to polishing. Polishing resistance is a special requirement for interior automotive coatings, so the use of waxes is limited in this application.

Pergopak® in Plastic Coatings

- The use of Pergopak® results in coatings of high abrasion resistance, excellent flexibility, an intense matting effect and superb surface smoothness as well as a soft-feel effect.
- In a 2C-PUR formulation, Pergopak® significantly improved scratch resistance and soft-feel effect versus a commonly used combination of silica and wax.



Blocking Resistance

Blocking resistance is an important factor for many coatings. Insufficient blocking properties of a coating causes items sticking together. Investigations with different matting agents and their influence on the drying process showed that organic matting agents have advantages regarding blocking resistance and the development of early mechanical strength. The drying speed is enhanced by the high absorption capacity of

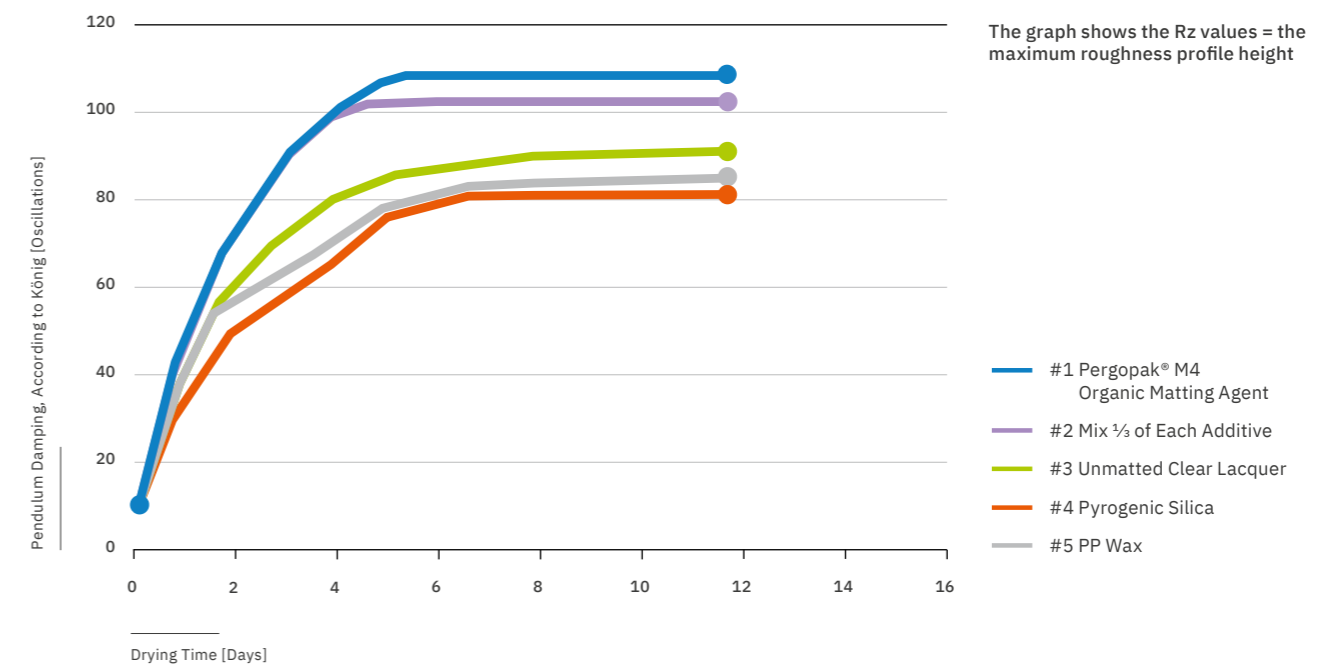
Pergopak® matting and effect agents, and, in this case, this effect is not dependent on the particle size distribution of the Pergopak® products used. Investigations comparing different kinds of matting agents also show that sometimes synergistic effects of mixtures can be observed.

Pergopak® in Coil Coatings

- Special demands are expected of the coating system with regards to rheology, adhesion and drying behavior.
- Incorporating Pergopak® results in coatings of greatly improved elasticity compared with inorganic matting agents. This is due to the free methylol groups in Pergopak® which can interact with the binder.
- In addition, Pergopak® significantly improves abrasion resistance, weathering resistance and elasticity while reducing gloss.



Pendulum Damping



The graph shows the Rz values = the maximum roughness profile height

Weathering

Lab experiments and long-term actual usage experiences show that Pergopak® organic matting agents in coating applications have positive effects on the UV stability of the film. In combination with some binders, the weathering resistance of the coating is improved. Since Pergopak® is a hydrophilic matting agent, some

tests involving moisture or humidity may lead to turbidity. This turbidity normally does not affect the durability of the coating such as its resistance properties or its gloss. The choice of special binder systems or the use of hydrophobic additives can enhance the stability against moisture.

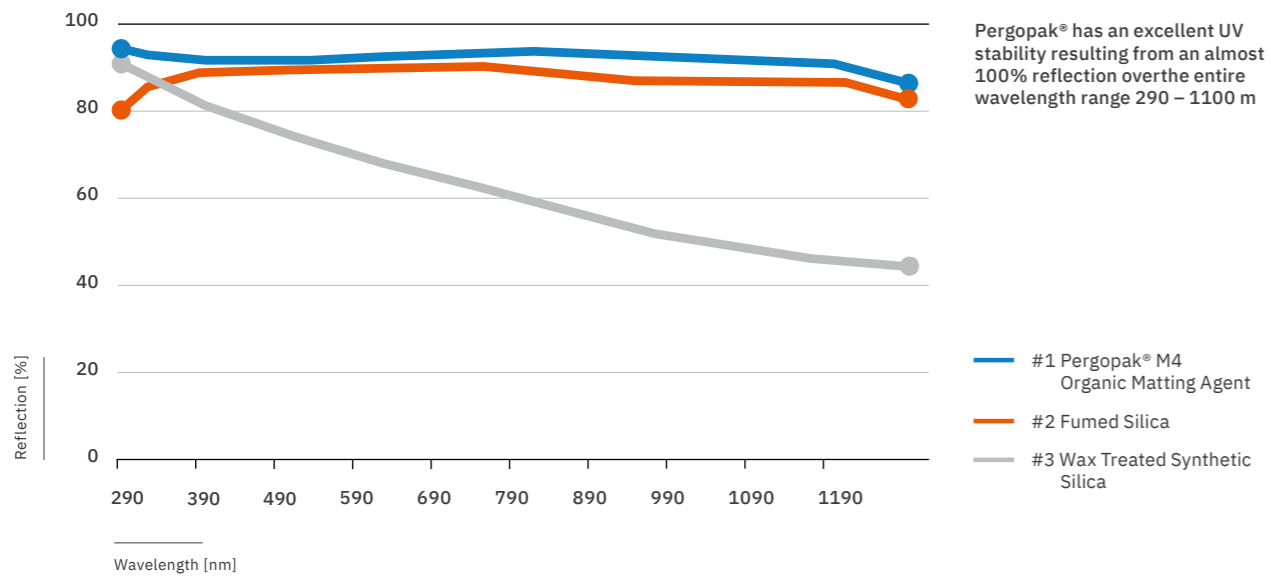


Figure 16

Advantages of Pergopak® Matting & Effect Agents

Pergopak® matting and effect agents provide a high performance balance of matting, clarity, rheology and abrasion resistance along with a pleasant feel versus that of other matting agent technologies used

alone. As thermoset polymers, Pergopak® products provide advantages in the overall resistance of the coating due to its hardness and non-melting properties.

Product Specific – General

- Narrow particle size distribution
- Large pore volume
- Chemical resistance
- Thermal stability (>200°C)
- Constant reflectance
- Inert, non-reactive
- No VOC (2010/75/EU)
- No SVHC, APEOs, BADGE, BFDGE, NOGE, Phthalates, Halogenated hydrocarbons, Heavy metals

Performance in Coatings and Inks

- | | |
|---------------------------------------|-----------------------------------|
| Incorporation at any formulating step | Gives warm look to wood |
| Easily dispersible | Good gloss retention |
| High shear resistance | Haptics – gives soft-feel |
| High scratch resistance | No adverse effect on printability |
| Minimal to no effect on rheology | Improves blocking resistance |
| High burnishing resistance | High coin-marking resistance |
| No adverse effect on recoatability | High transparency |



The Value of Pergopak®

Pergopak® Features	Benefits	Ultimate Pergopak Value
100% organic • No silica	<ul style="list-style-type: none"> More compatible and wets-out by resin better than silica Better coin marking and mar resistance vs. silica Retains soft feel affect with soft feel urethanes vs. silica 	<ul style="list-style-type: none"> Produces coatings with better performance and durability Produces coatings with better haptics (feel)
Higher bulk density than silica (80 kg /cubic meter)	<ul style="list-style-type: none"> Mixes into the let-down more easily in both water and solvent based systems vs. silica Mixes in with less dusting 	<ul style="list-style-type: none"> Faster throughput • Higher productivity • Reduced energy costs • Easy to adjust gloss after batch is made Reduced dust hazard • Improved environmental practices
Has no silanol (SiOH) groups	<ul style="list-style-type: none"> Stable viscosity in water-based systems Not a thixotrope Increases viscosity less than silica in solvent and 100% reactive systems More Pergopak can be added to lower VOC and lower gloss with better rheology 	<ul style="list-style-type: none"> Stable and predictable rheology Better balance of rheology vs. silica alone • Able to achieve low gloss levels with excellent flow and leveling
Hard, thermoset plastic powder	<ul style="list-style-type: none"> Similar heat resistance vs. silica 	<ul style="list-style-type: none"> Used in heat cure and air dry systems • Maintains heat durability performance
Refractive index of 1.607	<ul style="list-style-type: none"> May have better clarity in some clear coatings Dependent on the index of refraction of the resin 	<ul style="list-style-type: none"> Can have better optical properties in clear coatings
Controlled PSD D90 <17, <14, <11, <6	<ul style="list-style-type: none"> The very fine grades used in thin coatings 	<ul style="list-style-type: none"> Can be used in all types of coatings
No aromatic rings	<ul style="list-style-type: none"> Good UV resistance and exterior durability Shelf life = 2+ years UV resistance similar to silica 	<ul style="list-style-type: none"> Maintain UV durability performance
Specific gravity of 1.47	<ul style="list-style-type: none"> Less dense than most fillers 	<ul style="list-style-type: none"> Tendency to settle less than other fillers
Organic nature	<ul style="list-style-type: none"> Not usually as efficient at matting vs. silica 	<ul style="list-style-type: none"> May have higher cost formulations vs. silica

Regulatory Status and Listing of Pergopak®

The Pergopak® product line is globally listed and is in compliance with the following regulations and directives:

21 CFR FDA 175.105, 175.300, 176.170, 176.180	Yes
California Prop 65	Approx. 600 ppm formaldehyde (NIAS)
CONEG Toxics in Packaging	Yes
Directive 2011/65/EC - amended EU/2015/863 (RoHS)	Yes
Regulation (EC) No 1935/2004	Yes
Regulation (EC) No 10/2011	Yes
Regulation (EC) No 2023/2006 (GMP)	Yes
Swiss Ordinance (SR 817.023.21) - Edition 12/2020	Yes
European Printing Ink Association (EuPIA) - 3rd Edition 12/2018	Yes
DIN EN 71-3:2019	Yes
DIN EN 71-9:2007-9	Yes (contains less than 0.1 % formaldehyde)
BFR recommendation IX	Yes
BFR recommendation XXXVI	Yes
Council Directive 94/62/EC	Yes
Recommendation (2011/696/EU) - Nanoparticles	No nano particles
Conflict Minerals (EU) 2017/821	Free

Our global footprint

Huber Advanced Materials is a global leader in organic matting agents and carriers, halogen-free fire retardants, smoke suppressants, thermal management solutions and specialty aluminum oxides.

Our innovation, advanced technologies, unique expertise, unsurpassed customer focus and technical know-how give us the edge to keep meeting the dynamic needs of tomorrow.

We deliver ideal application solutions to enhance the performance, appeal and processing of a broad range of industrial, agricultural and consumer products.

For more information on our complete line of Pergopak® organic matting agents and to order samples, contact us today.

Americas

Fairmount, GA
Atlanta, GA
Kennesaw, GA
Marblehead, IL
Bauxite, AR

Europe

Bergheim, Germany
Breitenau, Austria

Asia Pacific

Qingdao, China



2

R&D Centers

6

Manufacturing Plants

3

Customer Care Centers

Visit Us Online at
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Huber Advanced Materials
Martinswerk GmbH
+49 2271 9020
info@martinswerk.com

Huber Advanced Materials
+1 866 564 8237
hubermaterials@huber.com



Huber Advanced Materials
HEM (Qingdao) Co. Ltd.
+86 532 58792008
hubermaterials@huber.com

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