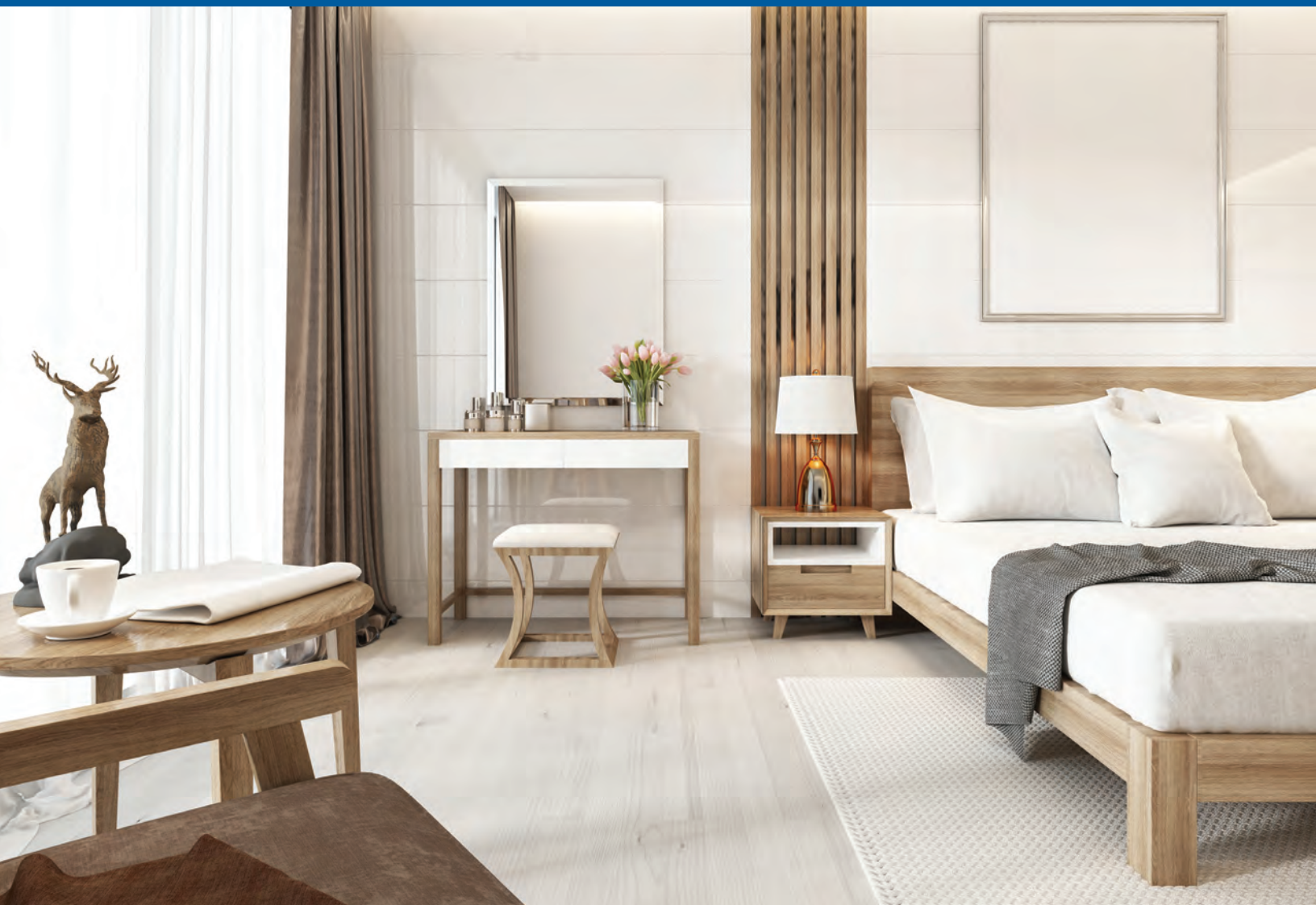
EASTMAN

Enhance appearance, durability and ease of application

2K acrylic urethane wood coatings

Eastman **SOLUS**™
performance additives



Application overview

Two-component (2K) acrylic urethane wood coatings are typically used on high-quality furniture or kitchen cabinets that must withstand regular use while maintaining stellar appearance. Consumers expect their furniture and kitchen cabinets to not yellow or fade over time. To prevent yellowing, manufacturers must pay special attention to the resins used in wood coating formulations. Successful application of the right coating will boost the immediate and long-term appearance of the wood. With Eastman Solus™ performance additives, formulators can create coatings that are easy to apply with the appearance consumers demand.

A 2K urethane coating is produced by the reaction of hydroxyl (OH) groups on a binder or polyol with isocyanate (NCO) groups on a hardener. The resulting urethane reaction produces a cross-linked structure that, if correctly formulated, exhibits excellent physical and chemical resistance.

Typical hydroxyl-containing resins used in 2K wood coatings include alkyds (normally, short-oil types), polyesters and acrylics. The choice of coating ingredients is dictated by the end-use requirements and often by the economics of the process. Typically, the least expensive 2K coatings are derived from alkyd resins combined with aromatic isocyanate or aliphatic/aromatic hybrid hardeners. The most expensive are typically acrylic polyols combined with aliphatic isocyanates. The presence of unsaturated double bonds in alkyd resins and aromatic components in the hardeners results in coatings that will typically darken in color and permanently yellow under UV light. In contrast, acrylic urethane coatings using acrylic polyols and aliphatic isocyanates are nonyellowing.

Solus™ performance additives are ideally suited to be used as modifying resins for acrylic urethane coatings for applications that require no yellowing. Typical applications include coatings for lighter-colored wood types, white or pastel colors, and clear-over-white coatings.

Product-in-use details

Solus™ has widespread use in high-quality 2K acrylic urethane systems for industrial wood coating applications. These performance additives are commonly employed as co-binders or additives to enhance application and performance characteristics. Solus™ offers appearance and application advantages to the 2K urethane wood coating system, including:

- Nonyellowing, even when exposed to UV light
- Correct balance of viscosity and solids content, offering excellent wetting, penetration and pore definition on open-pore wood species
- Fast hardness development, allowing early stacking and processing of coated products
- Superior control of silica matting aids, delivering consistent gloss levels — particularly at different film thicknesses
- Excellent flow and leveling characteristics, enabling defect reduction and enhanced appearance
- Excellent atomization and application characteristics

Eastman Solus™ enables excellent weathering and penetration due to the balance between viscosity and solids content. Higher- and lower-viscosity esters in Solus™ are used to adjust viscosity and solids where appropriate. In many instances, formulators work with Eastman technical experts to leverage the range of molecular weights found in the Solus™ portfolio, balancing physical drying requirements, solvent usage, VOC targets and formulation cost. Where higher block resistance is needed, resins with a higher OH content are added for the higher glass transition temperature (T_g) and resulting hardness. Some formulators also use Solus™ to improve compatibility and solubility thanks to higher butyral content.

Evaluation of Solus™ in 2K acrylic urethane wood coatings

A series of starting point formulations were used to demonstrate the effect of adding Solus™ resins to a 2K acrylic urethane wood coating.

The evaluation involved a comparison of a semigloss control formulation without Solus™ against formulations where Solus™ was used to replace part of the acrylic polyol. An additional formulation involved replacing a smaller amount of the acrylic resin with a higher-molecular-weight ester. The study focused on a visual assessment of appearance, the Persoz hardness development over one day and 18 days, and the effect of the Solus™ addition on the gloss of the formulation. This work was performed by Centre Technique du Bois et de L'Ameublement (CTBA), an independent testing laboratory now called l'Institut Technologique Forêt Cellulose Bois-construction Ameublement (FCBA) in Paris. The CTBA was chosen for its expertise in the furniture coatings industry and its facilities that offer the semi-industrial application conditions desired for this study.

Since wood coatings are typically comprised of a minimum of one base coat and one topcoat, a formulation containing 5.8% Solus™ was used as a common base coat system for all panels. The coatings were applied directly onto glass mirror plates for the hardness development study.

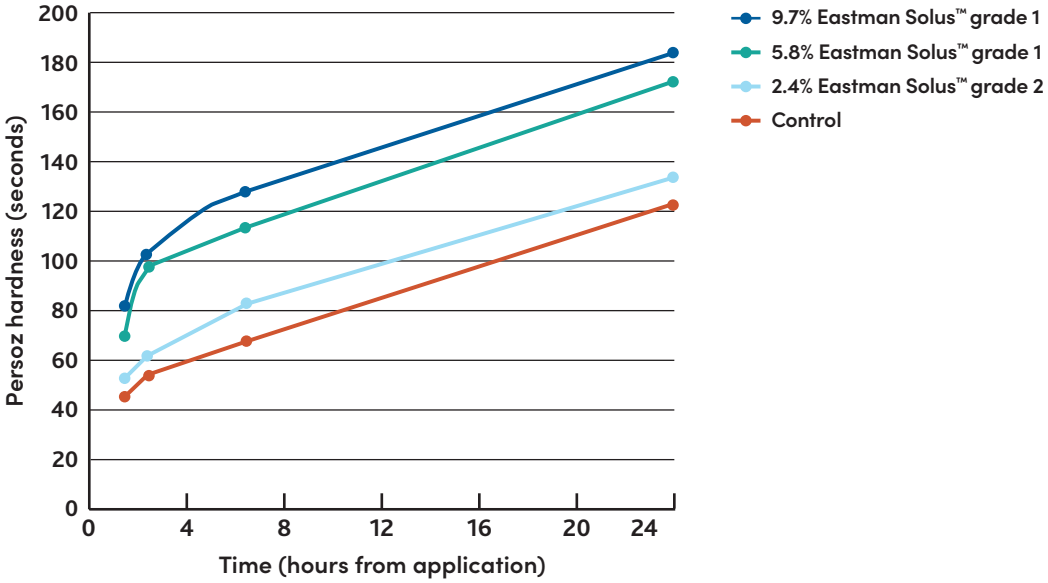
After a period of conditioning, several performance evaluations were made. Hardness development (according to NF EN ISO 1522) and gloss (according to NF EN ISO 2813) results are described in the following sections.

Hardness development

Early hardness development (24 hours)

One of the key features of adding Solus™ to an acrylic urethane coating is that the hardness development in the early stages of drying is greatly increased. Figure 1 shows this hardness development and the effect of increasing Solus™ in the formulation. This allows the applicator to either polish or stack the coated article earlier in the production cycle. The formulation without Solus™ would be too soft and would block under pressure. Note the effect of replacing a portion of acrylic polyol with a small amount of a higher-molecular-weight Solus™. The hardness development of the formulation is significantly improved when compared to the formulation without Solus™.

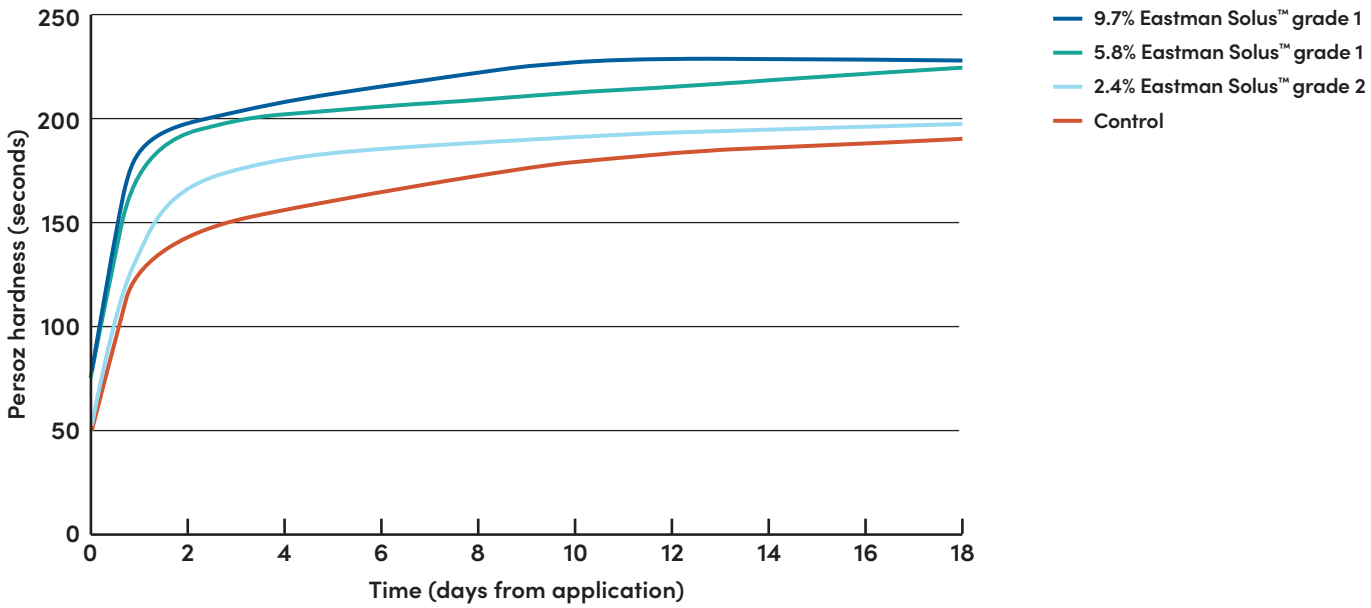
Figure 1. Persoz hardness development (24 hours)



Hardness development over 18 days

Figure 2 illustrates that the hardness of the applied coatings continues to increase with time. However, the control formulation (without Solus™) did not reach the hardness achieved with the addition of Solus™, even after 18 days. Such improvements in hardness development will lead to greater factory throughput, since the coated articles can be easily processed and transported without risk of damage due to the films being too soft. The hardness increase over 18 days also indicates improved durability and freedom from blocking while furniture is being stored and transported.

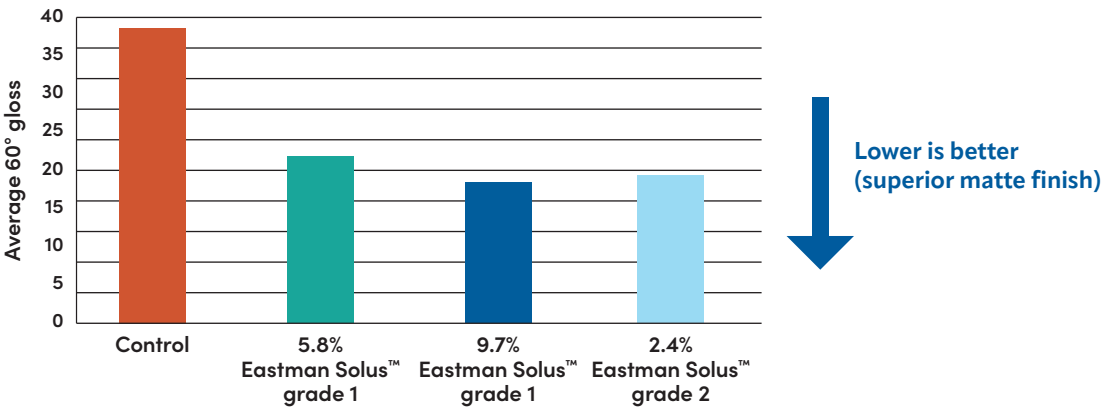
Figure 2. Persoz hardness development over 18 days



Gloss — silica matting aid and gloss control

Although all the formulations shown in Table 1 were made with an equal ratio of silica matting aid to resin, the use of the Solus™ resin serves to disperse the silica more efficiently than the acrylic-only formulation. In addition, Solus™ increases the viscosity of the coating so that the spray solids are reduced at application viscosity compared to the control. This provides film shrinkage and thus a more effective orientation of the silica, resulting in lower gloss. Such levels of gloss control can be significant in articles coated with variations in applied film thickness, typically resulting in thicker coatings with higher gloss levels. Using Solus™ performance additives in the formulations leads to a more even gloss independent of film thickness. Figure 3 shows the effect of adding Solus™ to the coating formulation.

Figure 3. 60° gloss measurement



Visual assessment of appearance on solid wood (oak)

The CTBA expert rated the appearance and application properties of the coating systems on oak panels in the following order:

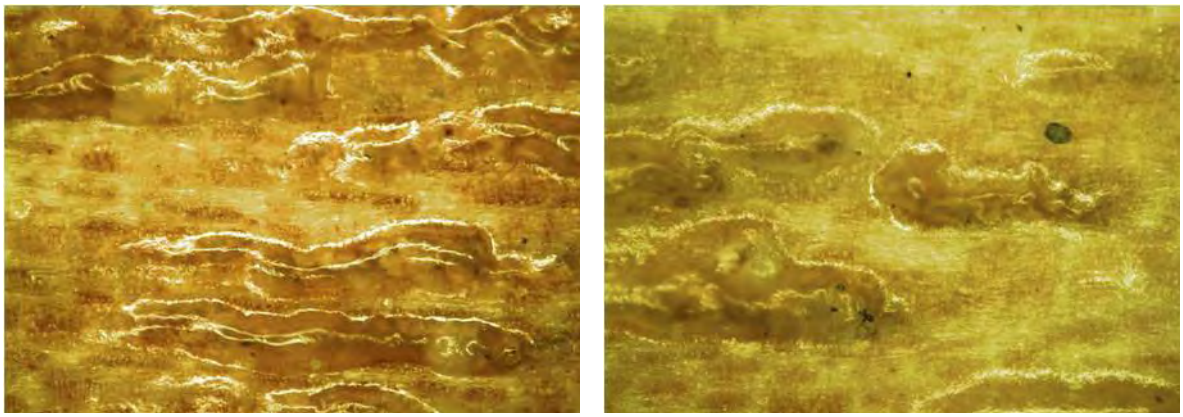
1. 5.8% Solus™ grade 1 coating system
2. 9.7% Solus™ grade 1 coating system
3. 2.4% Solus™ grade 2 coating system
4. Control coating system (no Solus™)

Figure 4. Properties of the coating systems on oak panels

Control **Solus™ formulation**

The wood coated with the formulation without Solus™ shows that the edges of the individual wood pores have a pronounced "frame" or thick edge. This was not observed to the same extent with the system containing 5.8% Solus™.

Figure 5. Magnified view of the pores of the oak panels



Control **5.8% Solus™ formulation**

Conclusion

Eastman Solus™ performance additives contribute to the drying and hardness development of wood coatings. This allows early handling, processing and stacking of coated wood furniture and panels, reduces detrimental blocking, and boosts throughput for the coating applicator. These performance benefits are especially noted in the early, critical stages of the drying process.

The CTBA experts reported that the coating systems containing Solus™ demonstrated improved flow, leveling, wetting and application characteristics compared to those without Solus™, mainly when used on open-pore wood. The study further demonstrated that the systems with Solus™ showed consistently lower gloss levels for equivalent matting-aid loading. This can result in more economical use of matting aids.

The results highlighted here confirm the benefits that Solus™ contributes to help furniture coatings achieve the desired appearance and manufacturing productivity demanded in high-quality industrial wood coating applications.

Eastman Solus™ performance additives are key ingredients in the formulation of high-quality wood coatings where high demands such as appearance and increased throughput due to fast drying are needed. Solus™ performance additives are completely nonyellowing in sunlight, and when coupled with nonyellowing ingredients such as acrylic polyols and aliphatic isocyanates, they enable formulators to produce nonyellowing, color-stable coating formulations for critical applications such as light wood types, white or pastel shades, or clear-over-white coatings for furniture.

Contact your Eastman technical representative or authorized Eastman distributor for help selecting the best Solus™ grade for your specific application. Starting point formulations used are available on request.

For nearly a century, Eastman has been the world leader in manufacturing specialty cellulose esters and has developed deep application expertise. Eastman Solus™ can help formulators achieve high performance, enduring beauty, sustainability and regulatory compliance. Because of the breadth of possibilities, this naturally derived cellulosic is ideal for many applications. It offers the consistency and quality that formulators require and brand owners rely on. Eastman Solus™ — the natural choice.

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