HIGH-RESISTANCE, INK-JETTABLE COATINGS FOR LONG-TERM OUTDOOR EXPOSURE

Christoph Hilgers and Andreas Haeuseler of Momentive Performance Materials, Germany, discuss the features and benefits of the company's hardcoats

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Momentive Performance Materials offers a wide range of products in the field of speciality coatings on plastic substrates. SilFORT™ hardcoats help enable the replacement only once of glass and metal with lightweight plastics in several demanding applications that cover a number of industries, such as automotive and architectural. SilFORT hardcoats help extend the long-term exterior durability and performance of plastics, such as polycarbonate (PC) and polymethylmethacrylate (PMMA), as well as maintaining their colour, gloss, light transmission and physical properties.

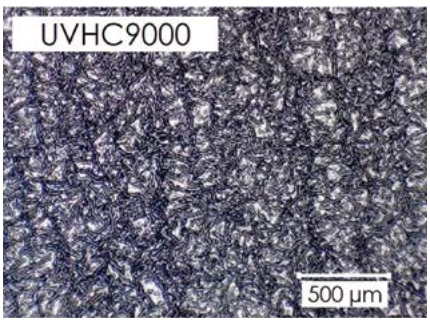
HARDCOAT ADVANTAGES

Momentive's hardcoats offer long-term weather, chemical and solvent resistance. They also provide excellent gloss protection, enhanced signal transmission and are easy to clean.

"Momentive's hardcoats offer long-term weather, chemical and solvent resistance"

The company's comprehensive range can be applied by various application methods. These include dip, flow, spray or digital-inkjet printing and can be used with a broad range of extruded parts, sheet materials, films and moulded parts. Typical examples of coated automotive interior articles with enhanced lifetime as a result of applying a SilFORT hardcoat are shown on page 8 (gear stick, switch and display). The parts were coated with SilFORT UV-curable coatings. The product line is named SilFORT UVHC (Ultra-Violet Curable Hardcoats) and cure is achieved via radical photopolymerisation. Momentive Performance Materials produce and use speciality UV-absorbers and

UVHC9000 coated garage door. © Hörmann KG Sales Company



Resulting surface-folding effect generating a low-gloss surface on a garage door. Test data. Actual results may vary

nanoparticle technology, along with the UVHC product line, to achieve mechanical reinforcement and enhanced weatherability.

For the application of SilFORT UVHC coatings, a lab-printing machine, supplied by CyanTec, was used. The printer is equipped with a Xaar 1003 printhead.

UVHC9000

Momentive developed a speciality long-term weatherable, ink-jettable low-gloss coating (UVHC9000) for industrial and automotive

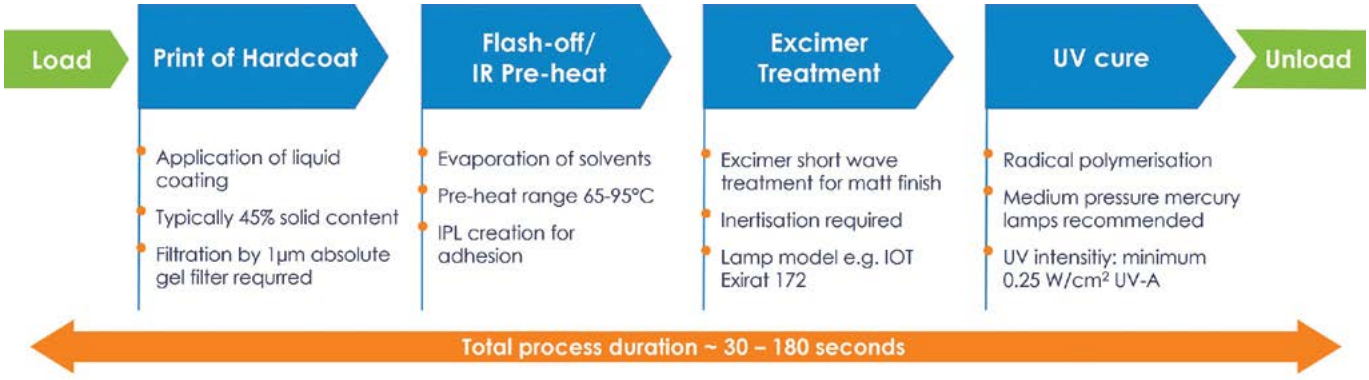
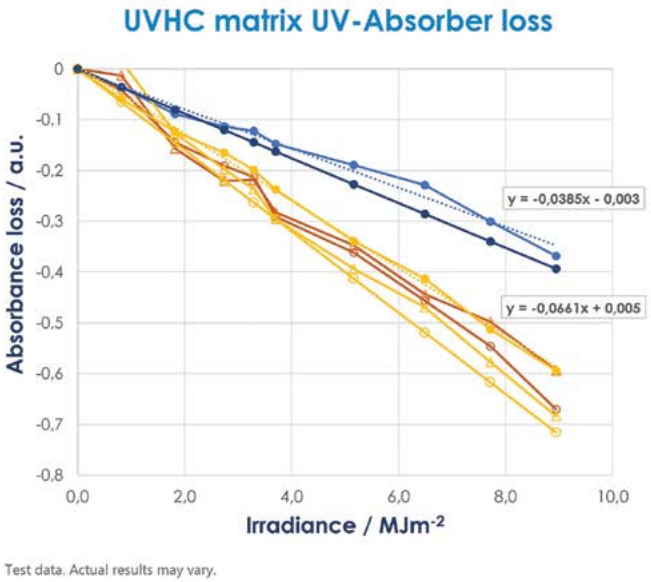


Figure 1: Coating process for SilFORT UVHC9000 with Excimer pretreatment and final UV cure

UV-Absorber type	Rate of Loss [A/MJm^{-2}]*
Benzotriazole	0.37
Triazine 1	0.20
Triazine 2	0.25
UV-Absorber UVHC	**0.04**
UVA 1	0.07
UVA 2	**0.06**
UVA 3	0.07

Atlas SUNTEST XLS

- 100 hrs ~1 month Florida exposure
- Maximum intensity 0.62 W/m² @340 nm
- Screening of commercially available UV absorbers



Test data. Actual results may vary.

Figure 2: Testing of the degradation of selected UV-absorbers by means of Xenon weathering (left) and monitoring the absorbance loss of specific signals via UV spectroscopy (right)

"Weatherability of UVHC9000 lasts for more than ten years"

applications. Low gloss was achieved without the addition of solid microparticles that usually generate low-gloss effects in wet coatings. Microparticles can potentially block the nozzles of commonly used printheads. Instead, a soluble matting agent was used in order to enhance the matting effect which is supported by Excimer-radiation (172nm).

Atlas Xenon weathering device

Weatherability of UVHC9000 lasts for more than 10 years according to DIN EN ISO 4892-2 or VW PV3930, dependent on the part orientation.

In the images showing the application of UVHC9000 and the diagram of layering on a garage door, the topcoat is digitally printed on a multi-layer structured surface. An ink-jetted decor is applied beneath the topcoat. The ink system is adapted to the final, digitally printed protective UVHC9000 layer.

The coating process is shown in Figure 1. After decor application, the topcoat is digitally printed on top of the UV-cured ink surface. The low-gloss effect is enhanced by an Excimer UV-lamp. Final cure is achieved with medium pressure UV lamps.

SilFORT UVHC coatings' weathering performance is well correlated to outdoor weathering in Florida or Arizona according to requirements described in the normal/ regulation SAEJ576/FMVSS108. Xenon weathering test setup as well as weathering in Miami (Florida, 45° south) is shown below.

UV ABSORBERS

The performance of SilFORT UVHC coatings is further affected by the degradation of UV absorbers used in UV-curable formulations.

Florida outdoor weathering field in Miami (45°, south)

The UV absorbers protect underlying substrates or inks from deterioration by yellowing, cracking or colour fading. Momentive developed its own UV-absorber technology. The stability of the absorbers, in specific composition, is tested by means of monitoring the degradation or typical absorbance signals utilising UV spectroscopy (Figure 2).

Momentive UV absorbers, with the lowest degradation rates (blue lines), are used in the SilFORT UVHC series in order to achieve ideal outdoor performance.

WEATHERING PERFORMANCE

Weathering results of SilFORT UVHC9000 are summarised in Figure 3. Haze and yellowness

Continued over

"The UV absorbers protect underlying substrates or inks from deterioration"

Layer stack on a decor surface segments using UVHC9000 as top layer

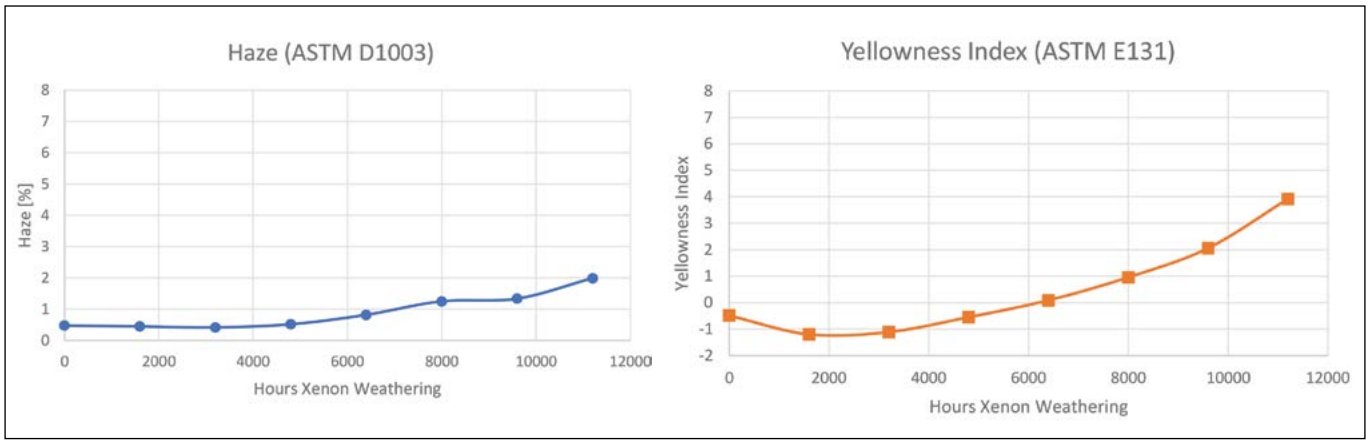


Figure 3: Weathering performance of SilFORT UVHC9000 on polycarbonate determined by accelerated Xenon weathering according to Volkswagen (VW) specification PV 3930 (45° Florida simulation). Yellowness index was measured according to ASTM E 313, haze according to ASTM D 1003 (copyright Hörmann KG Sales Company)

Switch cover

Display cover

data are shown according to ASTM D 1003 and ASTM E 313 as critical parameters to monitor coating performance. Yellowness data is critical on PC substrates since the BPA-moiety (Bisphenol-A) has a high tendency to photo-oxidise[1].

The weathering data for UVHC9000 in Figure 3 shows a very low haze increase and yellowness values within the requirements mentioned in the norm SAEJ576 up to an equivalent seven years of weathering according to VW PV 3930. The simulation is correlated to a 45° exposure. The calculated lifetime of a vertically positioned part is more than ten years due to the lower impact of the solar irradiance[2].

The abrasion performance of SilFORT coatings is achieved by adding organically modified SiO_2-nanoparticles. Due to reinforcement with inorganic additives, the scratch and abrasion performance versus standard automotive coatings – such as polyurethane systems (PUR) – is significantly increased (Figure 4).

SUMMARY

Low-gloss coatings, with high-abrasion resistance and outstanding weathering performance, can be applied with conventional printheads. This application can be used without established microsphere technology to achieve matting effects.

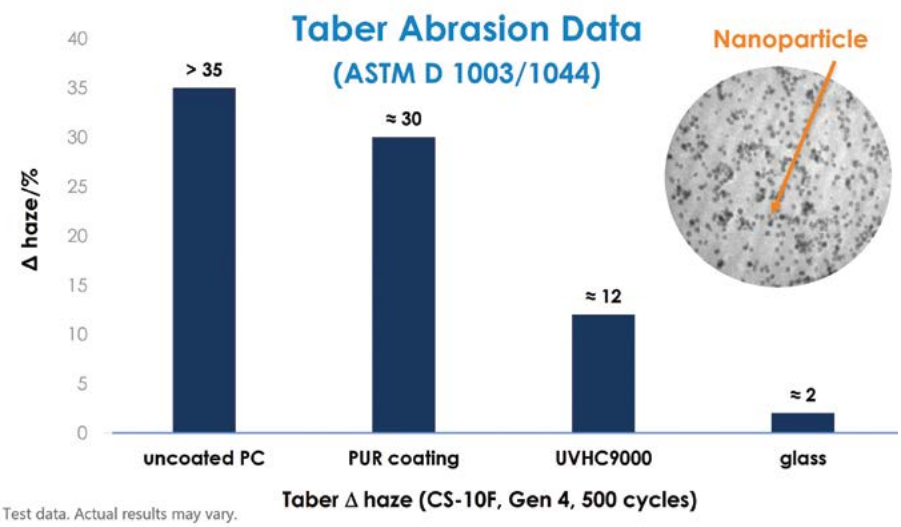


Figure 4: Abrasion performance of different substrates and coatings versus glass according to ASTM D1003/1044 (PUR: polyurethane)

Gear-stick cover

Therefore, a robust application process can be achieved without the risk of printhead nozzle clogging and high scrap levels. The coating system can be used to protect underlying printed inks and sensitive substrates. ■

References

1 *M Diepens, P Gijsman, Polymer Degradation and Stability, 92,397–406 (2007)*

2 *Calculated from annual weather reports, Atlas Weathering Service Group*

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