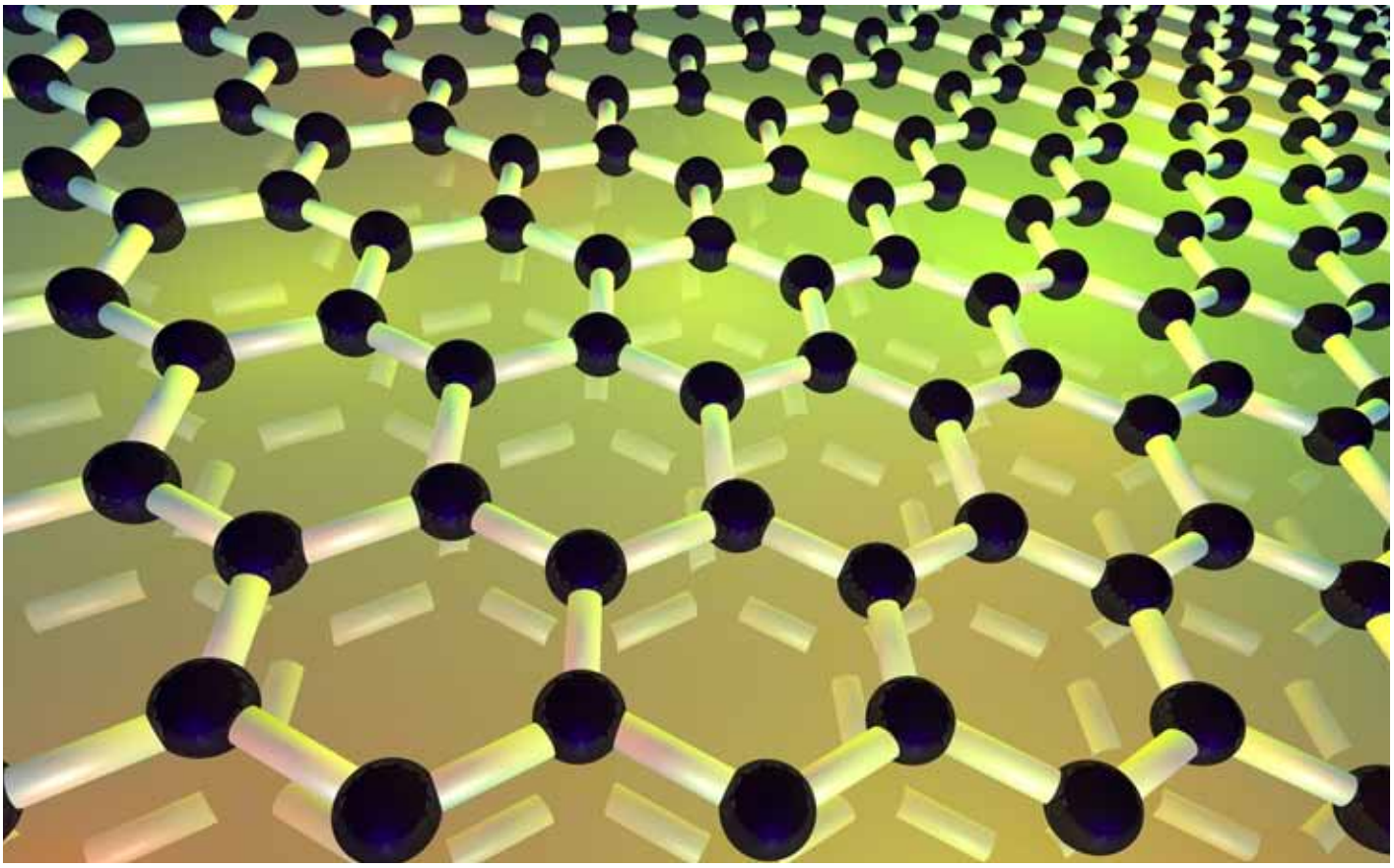
FreiLacke

UltraHighSolid single-coat-system for high-tech applications

The 2C UltraHighSolid single-coat-system fulfils all requirements of high-tech applications. In addition, the coating system also allows for cost savings in production and logistics.



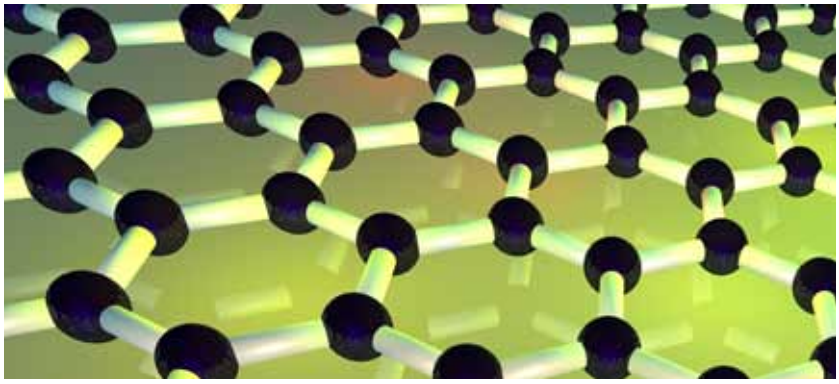
UltraHighSolid single-coat system
Cost savings in production and logistics

High requirements placed on coating systems

Ever-increasing requirements are being placed on coating systems, whether they pertain to surface quality or the efficiency of the coating process. In addition, there are also VOC requirements, which are leading to the rising use of environmentally friendly water-borne coatings, powder coatings and high-solid systems. Users are looking for coating systems with an approx. 80 percent solids content by weight in order to safely stay below the VOC threshold of 420 g/l. These types of system can also be described as ultra high-solid systems.

The requirements placed on high-quality industrial coatings are conventionally met using multi-layer coating structures. As well as cathodic ECs, 2C epoxy primers are also used in combination with 2C PU top coats. This coating system boasts excellent coating properties, both in terms of adhesive strength and corrosion protection and in terms of surface properties, UV resistance and chemical resistance.

The disadvantages of this process are the use of several coating systems as well as the increased time required for application and/or evaporation/drying, which generally results in higher coating costs.



Single-coat system with multi-coat properties

EFDEDUR single-layer coating UR1422

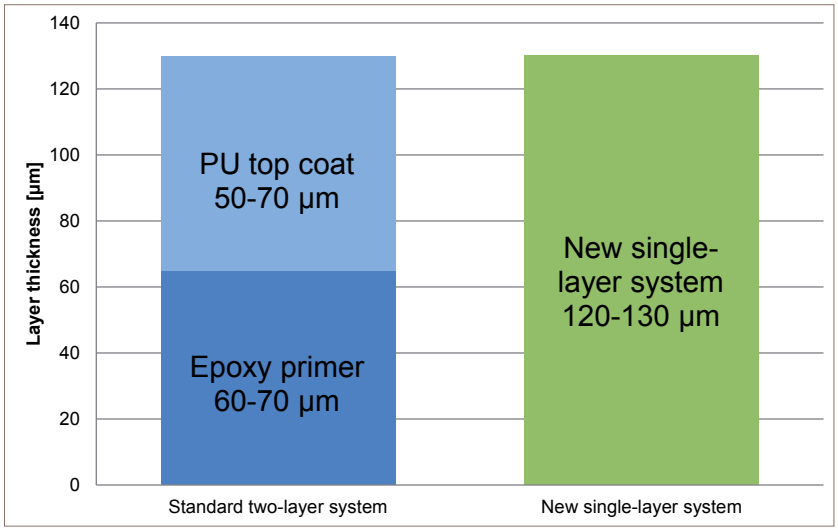
Single-coat systems previously available on the market came with disadvantages in terms of application drying times or achievable dry film thicknesses. Limitations were encountered when applying these on blasted substrates and when covering complex components.

FreiLacke has developed a 2C one-coat system with a solids content of approx. 80 percent by weight that uses the latest generation of raw material components. The system therefore meets the requirements for high-grade coatings with high popping-free layer thicknesses, drying that meets the needs of real-life situations and good surface properties all at once. At the same time, the resistance levels achieved thanks to corrosion protection correspond to those of the multi-layer systems described. The VOC content of the coating system is significantly below the VOC limit value.

Application of the end layer thickness in one coat for short cycle times

Short cycle times during application

Unlike standard multi-layer systems, the entire coating thickness can be applied in a single step using the new coating system. The elimination of intermediate flash-off time and the interim forced drying of the primer where necessary mean that cycle times for the coating can be significantly reduced. In addition, solvent savings – especially for cleaning purposes – can also be realised.
The properties of the new EFDEDUR UHS single-layer coating UR1422 compared to a previous standard two-coat structure consisting of FREOPOX HighSolid-primer ER1980 or ER1912 and EFDEDUR HighSolid-coating UR1991 are made clear below.



Comparison: classic two-coat structure and single-coat structure

Adopting a new single-coat system means that, in addition to increasing throughput, it is also possible to pare down on coating lines. By moving to a single-coat system, handling of the coating materials is also optimised with regard to logistics and storage. As well as that, it is possible to avoid any coating product mix-ups during operating processes.
The advantages relating to VOC emissions that result from the significantly higher solids content of the new coating systeme are listed in Table 1. The values of the total emissions per coated surface indicate a reduction in the VOC content of the new single-layer system of approx. one quarter.

System	Dry film thickness [µm]	Solids content [weight %]	VOC [g/l	VOC [g/m²]	VOC total [g/m²]
One-coat system	130	77	350	81	81
Standard two-coat structure					
Primer	70	69	440	63	106
Top coat	60	69	395	43	

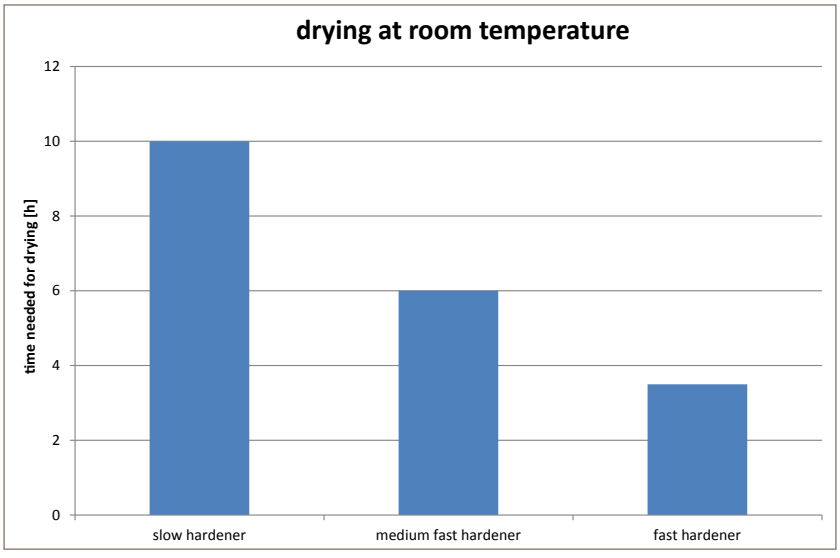
Table 1: Comparison of total VOC values

Controllable drying times
Variable gloss levels

Drying and gloss

The temperature range of 18 to 25 °C as well as a relative humidity of 40 to 70% have proven to be especially suitable application conditions. Application of the coating material should preferably be air-assisted. However, application can also be carried out using an airless process or by means of conventional air atomisation without any problem. Drying can take place at room temperature or be accelerated by increasing the temperature to up to 90 °C.

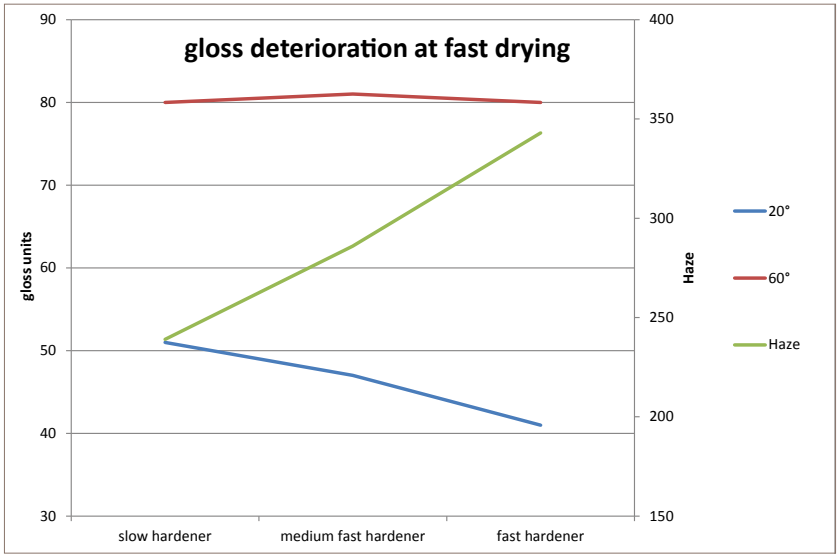
The drying speed can be controlled by using different curing agents. It must noted, however, that high-gloss systems cannot be achieved at just any high drying speed.
Gloss levels from 60 to 85 GU (angle 60°) are normally possible without any problem. Lower gloss levels are usually associated with a range of limitations such as poorer flow properties.
The time between coating and further processing components can vary widely depending on the curing agent used with the single-coat system.
The following diagram shows the drying time required at room temperature in order for the coating to be dry to the touch so that it can be further processed.



Drying times using curing agents of differing speeds

As illustrated in the diagram above, the time required before further processing can be reduced by 6.5 hours using the fast-acting curing agent compared to the slow-acting curing agent.
The following diagram shows what effect this has on gloss levels.

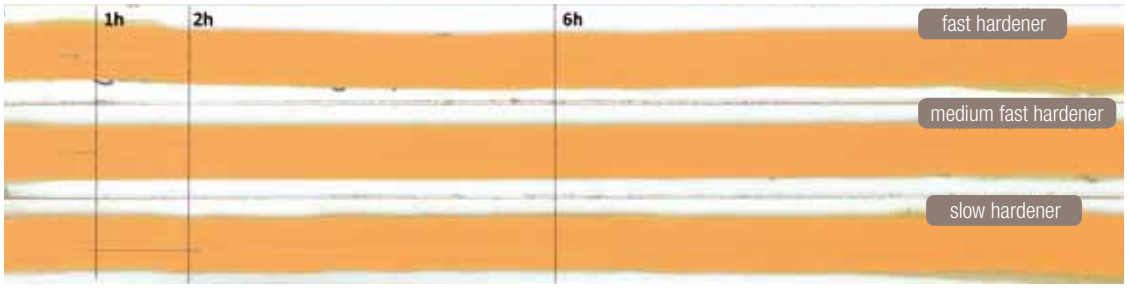
High, popping-free layer thicknesses thanks to excellent stability



Gloss and haze using curing agents of differing speeds

This diagram shows that the same consistent gloss level is measured at a 60° angle, whereas the gloss level at a 20° angle is reduced as the drying speed becomes faster, i.e. haze increases. This equates to a reduction in gloss when drying is accelerated.

The following diagram shows drying times as recorded by a drying recorder. This involves pulling a 10 g needle over a coating film applied with squeegee across a distance of 30 cm at a constant speed for a period of 12 hours Different areas can then be seen on the coating film. While the coating is still runny at the start of the test, the needle perforates the coating after a certain period of time. After the coating film has further dried, the needle is pulled across the coating again and leaves behind a scratch mark at most.



Drying determined by drying recorder (12 h and 2 weights at 5 g)

Stability and popping limit

Particularly worthy of mention are the stability and popping limit of the single-layer system. Dry film thicknesses of up to 150 µm can be achieved in one coat without running. The maximum possible popping-free layer thickness depends on the method of application. Even using the airless method, which often results in popping, a popping limit of over 200 µm for dry film thicknesses is achieved.

Top levels of resistance and corrosion protection

Anti-corrosive properties

To achieve a high degree of resistance and corrosion protection, a range of substrate pretreatments such as zinc phosphating, iron phosphating or sandblasting is recommended for single-layer coatings on steel. Table 2 shows the results obtained compared to a standard structure with two possible pretreatment methods in each case (DIN EN ISO 9227 NSS).

Load duration 500 h	Standard two-coat structure ER1912 & UR1991		UHS single-layer coating UR1422	
Substrate	Steel, blasted	Iron phosphate coating	Steel, blasted	Iron phosphate coating
Creepage from scribe [mm]	1	1-3	0.5-2	0.5-4
Adhesion	GT 1	GT 1	GT 0-1	GT 0-1
Degree of blistering	0 S(0)	0 S(0)	0 S(0)	0 S(0)
Degree of rusting	Ri 0	Ri 0	Ri 0	Ri 0

Table 2: Results of salt spray test

Salt spay test on single-coat system after 500 h

Load duration 500 h	Standard two-coat structure ER1912 & UR1991		UHS single-layer coating UR1422	
Substrate	Steel, blasted	Iron phosphate coating	Steel, blasted	Iron phosphate coating
Adhesion	GT 1	GT 1	GT 0-1	GT 0-1
Degree of blistering	0 S(0)	0 S(0)	0 S(0)	0 S(0)
Degree of rusting	Ri 0	Ri 0	Ri 0	Ri 0

Table 3: Results of the condensed water test in accordance with DIN EN ISO 6270-2 CH

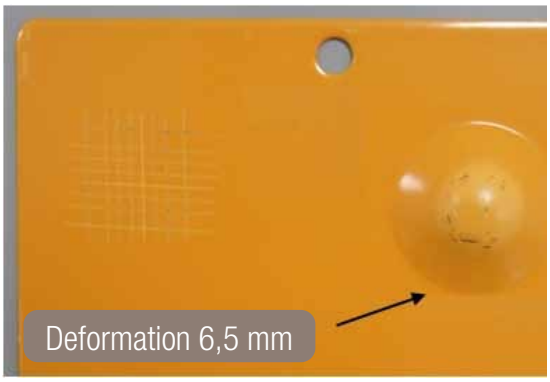
Chemicals	Softening	Colour shift	Gloss change
Diesel	0	0	0
Super unleaded	2 (reversible)	0	0
Brake fluid	2 (reversible)	0	0
Hydraulic oil	0	0	0
Engine oil	0	0	0
Gear oil	0	0	0
Phosphoric acid 20%	0	0	0
Sodium hydroxide solution 30%	0	0	0

Table 4: Chemical resistance according to DIN EN ISO 2812-1

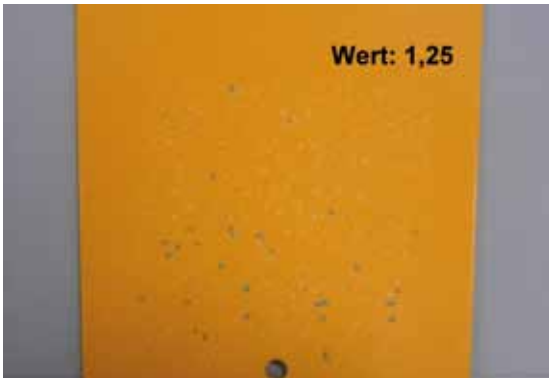
Outstanding mechanical resistance

Mechanics

It is especially the case in industries such as vehicle construction that coating systems are expected to be sufficiently flexible after curing is complete. This means that fully prepared coating films need to be able to resist any deformation of the coated substrate without cracking.
Standard coating structures are usually only moderately flexible, because a less flexible epoxy primer is often used.
By contrast, the single-coat system boasts outstanding values with respect to deformation and stone-chip resistance. When performing the Erichsen cupping test (DIN EN ISO 1520), a value of over 6 mm deformation can be achieved before initial cracks appear.
Moreover, stone-chip resistance (in accordance with DIN EN ISO 20567-1, part B) is excellent with a value of 1.25.



Erichsen cupping test



Stone-chip resistance test

Single-layer textured coating with 88% solids content

The smooth EFDEDUR UHS single-layer coating has a solids content of 80%. This figure is also the current limit for most colour shades.
However, FreiLacke's recently developed single-layer textured coating can also be applied with a higher solids content of 88%.
This product is the first alternative for areas of application in which only very low VOC emissions are permitted. Due to limitations with regard to viscosity, only gloss coatings can be formulated at present time. However, the drying speed can also be regulated here by using different curing agents.

Single-layer textured coating

VOC-compliant coatings
Drastically reduced VOC emissions

Table 5 shows to what extent volatile organic compounds can be reduced by using such a system. Compared to the smooth single-coat system, VOC emissions can be reduced by around half again per coated square metre.

System	Dry film thickness [µm]	Solids content [weight %]	VOC [g/l]	VOC [g/m²]	VOC total [g/m²]
Single-layer textured coating	130	88	228	40	40
Standard two-coat structure					
Standard primer	70	69	440	63	106
Standard top coat	60	69	395	43	

Table 5: Comparison of total VOC values for single-coat and standard two-coat structure

Table 6 shows the results of a salt spray test and condensed water test in accordance with the aforementioned standards. The results were the same for both substrates tested (blasted steel and bright steel) after 240 h of testing.

Assessment after 24 h regeneration	Creepage from scribe [mm]	Bubble formation	Degree of rusting	Adhesion
Salt spray test [240 h]	0	0 S(0)	Ri 0	GT 0-1
Condensed water test [240 h]	-	0 (S0)	Ri 0	GT 0-1

Table 6: Results for single-layer textured coating according to specified resistance tests

Are you interested? Then get in touch with our experts.
Emil Frei GmbH & Co. KG Döggingen Am Bahnhof 6 D-78199 Bräunlingen
Phone +49.77 07.151-0 Fax +49.77 07.151-238 info@freilacke.de www.freilacke.com