

## MATT CLEAR ACRYLIC POWDER COATING

# New Design for Light-Alloy Wheels

Acrylic powder coatings are well established as the standard material for coating light-alloy wheels in either single or multilayer systems. Thus far, the coating has only been applied with high-gloss systems. The development of a matt acrylic powder coating offers new design possibilities.

For new systems in particular, clear acrylic powder coatings are today applied to light-alloy wheels. Single or multiple layers (powder-coating primer and water-based or solvent-borne basecoat) are applied to the wheels with clear acrylic powder coating as a top coat. The optical requirements are maximum transparency, the highest possible gloss level and optimum levelling properties.

The aim now is to develop new possibilities in terms of visual appearance. In addition to the classical high-gloss look, chrome surfaces are becoming increasingly popular in Europe. In some parts of the premium sector, matt liquid top coat systems are used. Together with the appropriate basecoats in either silver or black-metallic, these top-coat systems create a very high-quality surface finish. Using a modern powder-coating system, the automotive industry wants to make the most of these design possibilities and to apply them to a broader sector.

In order to generate new design possibilities, and thus to meet all the specifications of both wheel manufacturers and the automotive industry, FreiLacke has developed a new, matt clear acrylic powder coating.

### Successful development work

When the raw materials were screened, the primary concern was to retain the



“chemical path” of the classical clear acrylic powder coatings – so-called GMA acrylates – so as to maintain the outstanding properties with regard to both weather resistance and corrosion resistance. Furthermore, the aim was to achieve fundamental compatibility with glossy, acrylic powder coatings; this only seemed possible with a comparable chemical basis.

In close collaboration with manufacturers of raw materials, the development group responsible tested a variety of suitable matting effects. Comparable liquid coating surfaces were available as approximate target values. However, due to the different properties of the powder coating compared to those of the liquid coating, these could not be matched on a one-to-one basis. In col-

laboration with a customer, various gloss-level settings were discussed and a comparison was made between their effects on original wheels in the overall structure.

As the matt surface cannot be assessed with established reflectometers, a subjective response was crucial to determining the gloss level. The customer specifically requested that the finished coating did not exhibit the coarse, pixelated structure of DryBlend classical powder-coating surfaces. The customer wanted a velvety and soft look to the surface.

A further challenge was presented by the dependence of the gloss level on the powder-coating layer applied. Here, the aim was to provide the processor with the widest possible controlled application window.

Within the project as a whole, the product was improved as required and modified in accordance with the customer's specific application. This reveals the mechanisms for how to respond to specific set-ups in coating plants.

### Promising test results

The specifications applicable to high-gloss clear acrylic powder coatings were tested. To allow the product to be used in all climatic conditions, optimum adhesion of the overall structure to the

substrate is essential (the substrate is either chromatised or pre-treated without chromium), as is the intercoat adhesion of the basecoat to the powder-coating primer and the adhesion of the acrylic powder top coat to the basecoat.

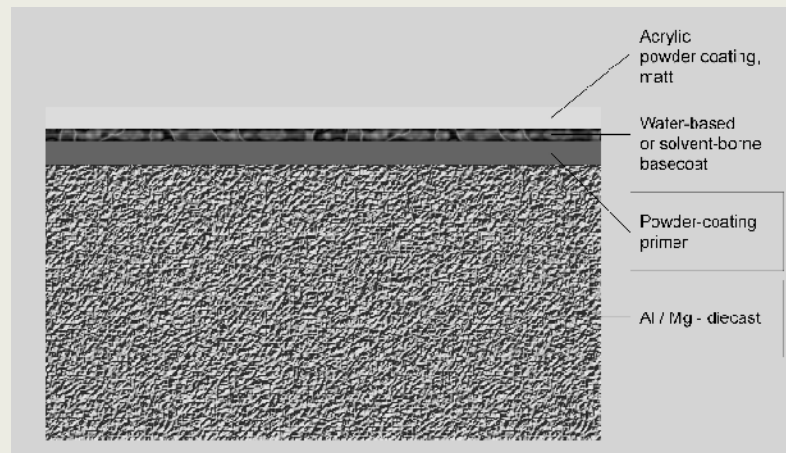
First and foremost, the wheel industry requires the so-called CASS test as per DIN 50 021 CASS (copper chloride, acetic acid salt-spray test) as a climatic weathering test. Other key tests are water immersion, hardness, chemical resistance and resistance to stone-chipping.

The UV or weathering stability was simulated in short-time tests (weatherometer) and the results are comparable with those of the clear liquid coatings and high-gloss acrylic powder coating system used. After a six-month test period, the results of the natural-weathering tests conducted in Florida are now available: there is no discolouration and the residual gloss is 100%. For this series of tests, the results are tracked for a minimum of 36 months.

### The handling properties

The product has been developed for pure electrostatic application (corona charging). The thickness distribution of the matt clear acrylic powder coating should be between 70 and 120 µm. Processing can take place in closed powder-coating booths at a temperature of 20 °C. The product should also be stored at a maximum of 20 °C. Due to the danger of cross contamination, the combined processing of GMA-based acrylic powder coatings and classical polyester or epoxy powder coatings is not generally possible.

The development objective of the fundamental compatibility of high-gloss and matt acrylic powder coatings has been met. With combined processing, pinholing or matting effects are not expected. In order to completely exclude the possibility of surface damage with the high-gloss system in particular, the use of a separate filter set or, even better, an extra application booth is recom-



The coating system of a light-alloy wheel with acrylic powder top coat, matt

Test	Standard	Actual value
Surface, visual	–	OK
Gloss level, visual	–	OK
Levelling, visual	–	OK
Cross-cut test	DIN EN ISO 2409	Gt 0 B
Hardness test rod	ISO 1518	15 N
Stone-chip resistance	DIN 55996-1	Characteristic value 0-1
Water immersion	32 °C / 240 h	OK
CASS test	DIN 50 021 CASS	OK
<b>Chemical resistance</b>		
Diesel fuel	VDA 621-412 test A	OK
Petrol, super unleaded		OK
Asphalt and tar remover		OK
Sealants and dewaxers		OK
Brake fluid DOT 4		OK
Solvent resistance	–	No bubble formation or softening
Xylene		

The test results for the overall coating system

Water immersion 32 °C / 240 hours	
Layer thickness of overall coating structure	250 – 300 µm
Cross-cut test as per DIN EN ISO 2409	Gt 0
Bubble formation as per DIN EN ISO 4628-2	m0/g0
Discolouration	None
Creepage from scribe	Wb < 1 mm

The test results for water immersion

CASS test as per DIN 50 021 CASS / 240 hours	
Layer thickness of overall coating structure	250 – 300 µm
Cross-cut test as per DIN EN ISO 2409	Gt 0
Bubble formation as per DIN EN ISO 4628-2	m0/g0
Creepage from scribe	Wb < 1 mm

The results of the CASS test

mended. Hardening takes 20 minutes in an indirectly-heated gas-fired powder coating oven at 170 °C object temperature.

### Starting series production

After successful field testing and the granting of the necessary approvals by a wheel manufacturer active at international level, series production will soon get underway. In view of the experience gained to date, no problems are anticipated. It will be interesting to see the particle spectrum and handling properties in circulation mode. To date, we have only conducted trials of this and do not have any long-term experience.

The possibilities of single-layer application on machine-polished wheels have not yet been examined. Other substrate treatments are conceivable as the basis for the one-layered application of a matt clear acrylic powder coating.

### Possible applications

It remains to be seen how well the matt surface will become established in the wheel industry. There is no doubt that we have succeeded in identifying alternatives to the familiar high-gloss looks. In addition to use on wheels, many other applications in the automotive industry could be suitable for the application of a more matt clear acrylic powder coating. For example, it could be used for roof rails, trim strips, windscreen wipers or add-on parts made of metal or plastic.

There are also attractive possibilities for this powder coating beyond the automotive industry, for example as a coating for bicycle frames, lights, metal furniture or bathroom fittings.

The design of a component is not the only aesthetic consideration; rather it is the combination of design and surface finish that is crucial to a product's appeal.

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