Two-layer powder coating

High levels of corrosion protection for actuators

Actuator manufacturer Auma Riester has changed over completely from paint to powder for coating its products. The purpose of the two-layer powder coating which the company is now using is to guarantee a high level of corrosion protection in tough operating conditions.

Actuators play a decisive role in all types of material flows and in the safety and economic viability of entire industrial plants. Actuator manufacturer Auma Riester, located in Müllheim in Germany, supplies its products to the water, energy, petrochemical and shipbuilding industries, among others. Operators of production plants use the actuators for their industrial valves.

The actuators are also required by valve manufacturers and companies responsible for planning industrial plants. The changeover from paint to powder in the production of the actuators gave rise to a number of different requirements.

For example, the powder must provide category C5-M corrosion protection (in accordance with DIN 55633). In addition, the design of the parts and the operation of the plant also had an impact on the quality of the coating.

Actuators in use in industrial plants must be able to withstand tough conditions and require highly effective corrosion protection.

Robust two-layer coating

Many companies choose to use single-layer powder coatings for applications where the coating has to withstand tough conditions. Auma Riester decided on a two-layer powder coating from FreiLacke (Table 1) in order to meet the requirements described above and, in particular, the corrosion protection specifications.

No zinc dust

The base coat consists of a specially modified epoxy resin with a high cross-linking density and very good adhesion

Powder coating	Basis	Curing	Oven conditions	Application	Coating thickness
Base powder coating PE1204A	Epoxy resin/Dicyandiamide	Polyaddition	10 min/160°C	Corona Tribo	60-80 µm
Top powder coating PU4003M	Polyester resin/IPDI uretdione	Polyaddition	12 min/200°C	Corona	60-80 µm

Table 1: Structure of the two-layer powder coating system (vertical system)

to a variety of metal substrates. Energy efficient powder coatings produce the required properties at cross-linking temperatures of 160 °C or more. For various reasons, the use of zinc dust was not considered for this base coat.

On the one hand, the electro-chemical cathodic corrosion protection effect of zinc dust cannot be guaranteed. On the other hand, the processing properties of zinc dust are poorer and it results in increased wear on the application machinery and causes surface faults in the top coat as a result of the large particles. The higher density of zinc dust would also reduce the cost-effectiveness of the coating process.

UV- and weather-resistant polyurethane top coat

The top coat is a polyurethane powder coating based on a polyester resin. The coating is cross-linked with isocyanate which is physiologically harmless and contains no cleavage products. Both the layers must be fully cured at a temperature of 200°C.

The two powder coatings are perfectly coordinated with one another to produce the required properties, in particular with regard to the adhesion between the top coat and the base coat.

The polyurethane powder coating was chosen because of its resistance to chemicals, UV light and the effects of weather. The glass transition temperature and the ease with which the coating can be decontaminated also make it ideal for this application.

In addition, the entire coating system acts as a barrier to prevent harmful substances from permeating and is designed for operating temperatures up to a maximum of 120°C.

VOC-compliant solution

The powder coating must also meet the requirements of current standards. Special anti-corrosion powder coating systems are in competition with conventional solutions consisting of several layers of paint. Because of the statutory requirement to reduce VOC emissions, the

Evaluation after 1512 hours		Cast iron	Die cast steel
Surface blistering	DIN EN ISO 4628-2	0-0 (S0)	0-0 (S0)
Delamination from cut edge	DIN EN ISO 4628-8	< 0.5 mm	0 mm
Surface corrosion	DIN EN ISO 4628-3	Ri 0	Ri 0

Table 2: Salt spray test in accordance with DIN EN ISO 9227 NSS using cast iron or die cast steel as a substrate. Evaluation after 1512 hours.

Salt spray test on cast iron (zinc-phosphated) after 1512 hours.

Salt spray test on die cast steel (zinc-phosphated) after 1512 hours.

Evaluation after 2016 hours		Cast iron	Die cast steel
Surface blistering	DIN EN ISO 4628-2	0-0 (S0)	0-0 (S0)
Delamination from cut edge	DIN EN ISO 4628-8	0.5 mm	0 mm
Surface corrosion	DIN EN ISO 4628-3	Ri 0	Ri 0

Table 3: Evaluation of the salt spray test after 2016 hours on cast iron and die cast steel substrates.

Salt spray test on cast iron (zinc-phosphated) after 2016 hours.

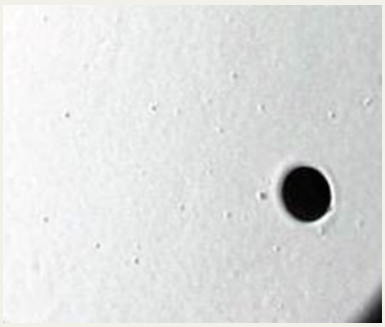
Salt spray test on die cast steel (zinc-phosphated) after 2016 hours.

Evaluation after 2520 hours		Cast iron	Die cast steel
Surface blistering	DIN EN ISO 4628-2	0-0 (S0)	0-0 (S0)
Delamination from cut edge	DIN EN ISO 4628-8	0.5 mm	0 mm
Surface corrosion	DIN EN ISO 4628-3	Ri 0	Ri 0

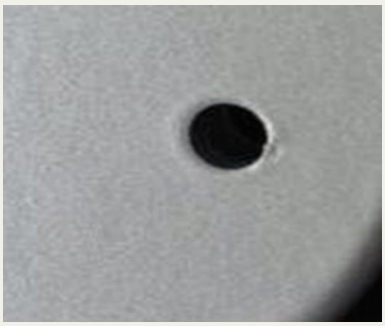
Table 4: Evaluation of the salt spray test after 2520 hours on cast iron and die cast steel substrates.

Salt spray test on cast iron (zinc-phosphated) after 2520 hours.

Salt spray test on die cast steel (zinc-phosphated) after 2520 hours.



Die cast component coated with a conventional powder coating in a critical metallic shade.



Die cast component coated with a degassing powder coating in a critical metallic shade.

trend for using solvent-free powder coatings is likely to continue to grow.

The main European standards for offshore corrosion protection are DIN EN ISO 12944-6 and DIN 55633, ISO 20340 and NORSOK M 501. DIN 55633 specifically concerns corrosion protection for steel structures with powder coatings.

Special two-layer powder coating systems are the ideal solution for all users who need to guarantee a high level of corrosion protection and for plant operators who want to move to powder as a result of the regulations on reducing VOC emissions from liquid paint. With emissions of below 0.1 percent, powder coatings produce the smallest amount of VOCs during the cross-linking process.

In order to ensure that the current requirements for steel structures are met and to guarantee results comparable with conventional liquid paint systems, the quality categories specified in DIN EN ISO 12944-6/DIN 55633 are often used.

The central feature of DIN EN ISO 12944 is a set of corrosivity categories combined with the expected protection period of the coating. The essential provisions of the international standard ISO 20340 are very similar to those of DIN EN ISO 12944. In order to provide the required level of protection, the coating must meet the requirements of corrosivity category C5-M with at least a “long” protection period.

Testing the two-layer coating

All the tests needed to comply with the standards have been carried out by Auma Riester on a variety of substrates. The salt spray test on cast iron, which is a highly demanding substrate, showed maximum corrosion creep of 0.5 mm after a test period of 2520 hours, which significantly exceeds the requirements of the standards. No changes in terms of adhesion, discolouration, blistering or corrosion were identified either during the tropical test or the test for chemical resistance.

The test results showed that the coatings complied with categories C5-I long and C5-M long in DIN EN ISO 12944 and fulfilled the requirements of ISO 20340.

Cast iron, die cast steel and sand cast steel are used at Auma Riester. These are all substrates with an increased tendency for outgassing. The risk is particularly high when metallic powder coatings are applied. The two-layer coating and the base coat specially designed for degassing have enabled Auma Riester to avoid degassing problems such as blisters and pinholing. After all the requirements had been met, it was possible to develop the coating relatively quickly and it was soon incorporated into Auma Riester’s production process.

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