New Cr(III)-based pretreatment

A simple, all-purpose, environmentally friendly process

A new conversion treatment based on Cr(III) has been developed as an alternative to iron phosphating for steel, zinc, aluminium and their alloys. The paint pretreatment offers higher levels of performance, a lower environmental impact and greater ease of use than conventional phosphating processes.

In the metal industry, iron phosphating, together with its accompanying passivation process, has been one of the standard paint pretreatments for around 100 years. Zinc phosphating is used, in particular in the automotive industry, to meet more demanding requirements. However, this type of coating offers limited corrosion protection and is relatively time-consuming to apply. The nanoceramic conversion coatings which have been on the market for some years represent a possible alternative, as they do not have some of these disadvantages.

In contrast to these coatings, the new Cr(III)-based conversion treatment (SurTec 609 ZetaCoat) from SurTec does not use nanoparticles dispersed in the bath, but instead incorporates an oxidic protective layer only a few nanometres thick during the process of creating the coating. Unlike nanoceramic coatings, the new conversion treatment is clearly visible, which means that simple visual checks can be carried out. The new process is ideal for pretreating and passivating a wide range of metals before painting or powder coating. It guarantees excellent paint adhesion and high levels of corrosion resistance.

The process uses no zinc, manganese, nickel, phosphate or nitrite and contains no mutagenic or environmentally hazardous additives, such as hydroxylamine or hydroxylammonium sulphate. The large amount of sludge that typically forms during phosphating processes is not present. The coating can be combined with the SurTec 609 A ZetaClean cleaner for simultaneous cleaning and conversion treatment.

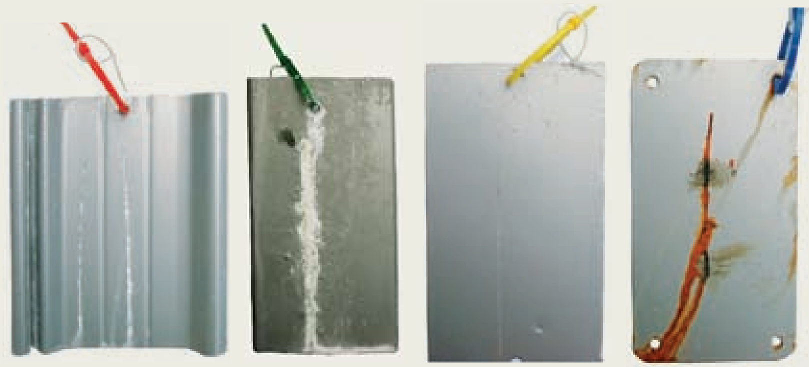
The best results in spray machines

The best results are produced when the product is used in spray machines with five or more stages. A typical application process is as follows: alkaline degreasing, a flow rinse with process water, a rinse with deionised water (maximum 350 µS/cm), passivation and a rinse with deionised water (ideal conductivity < 50 µS/cm). In order to clean the substrate as efficiently as possible, additives must be included in the degreasing bath, depending on the level of contamination of the parts. If sensitive materials, such as aluminium or zinc, are being treated, a product with a lower level of alkalinity should be used to prevent etching of the substrate.

The pretreatment changes the colour of the metal which allows visual checks to be made.
Left: Steel surface with a conversion layer
Right: Untreated surface

	Test in the SurTec laboratory (under-coating corrosion)	Test in an independent laboratory (under-coating corrosion)
Cold rolled steel	1 mm	0-1 mm
Hot-dip galvanised steel	0-1 mm	0 mm
Zinc-plated steel	3-5 mm	4 mm
Aluminium	0 mm	0 mm

Table 1: Results of a 600 hour salt spray test in accordance with DIN SS 50021 (EN ISO 9227)



Hot-dip galvanised steel | Zinc-plated steel | Aluminium | Zinc-plated steel

The coating provides excellent corrosion protection on all substrates (600 hour salt spray test in accordance with DIN SS 50021)

The temperature of the bath should be in the range 45 to 60 °C. Lower temperatures can cause foam to form and significantly reduce the cleaning effect.

In order to prevent alkaline solutions from being transferred into the pretreatment bath, the parts must be thoroughly rinsed. The conductivity of the water in the final rinse must not exceed 50 µS/cm. Higher figures will result in excessive consumption of the process solution. The quality of the water used will have a direct impact on the corrosion protection offered by the system.

The dwell time in the bath can be very short, but should not be less than 20 seconds. The operating temperature is 20 °C and therefore the solution does not need to be heated. The pH value must be between 4.0 and 5.0 and the use of an automated pH control system is recommended. A filter unit is not required.

Visible coating

If steel parts are being coated, the colour of the solution will change after a few hours from light green to reddish brown. This discolouration has no impact on the function of the solution. After treatment the colour of the coating will range from silver to shades of gold, depending on the quality of the steel and the bath parameters. The difference in colour bears no relation to the level of corrosion protection. However, it does allow a visual check to be made to determine whether a batch has been treated and how evenly the coating has been applied.

The ZetaCoat process can be used on a wide variety of different metals. Under ideal conditions, a visible coating is created on aluminium surfaces, which distinguishes this process from nanoceramic layers.

The coating provides a high level of corrosion protection (DIN SS 50021/ ISO 9227/ ASTM-B117) and very good paint adhesion (EN ISO 2409:1994) on steel, aluminium and zinc-plated substrates (table 1).

The 609 ZetaCoat pretreatment is based on trivalent chrome, which forms oxidic layers in the nanometre range. Although the coating has ceramic properties, it is not formed using a dispersion of nanoparticles. For this reason, it is similar to nanoceramic layers, but has a different formation mechanism and therefore belongs in a class of its own.

Suitable for a variety of metal surfaces

The pretreatment can replace iron or zinc phosphating under almost any circumstances. It is ideal for plants which are used to coat different metal surfaces and for users who need to pretreat large areas to high quality standards. The need for a more environmentally friendly process may be the incentive to move to the new pretreatment, for example in areas where the phosphate content of waste water is restricted.

In the case of powder coating, the pretreatment produces the best results with epoxy/polyester or pure polyester. Tests are currently being carried out into the suitability of the process for use with water- and solvent-based paints and with electrophoretic coatings.

Easy process control

The process is very easy to manage. It is sufficient to measure the acidity of a simple acid-base titration, the pH (ideal value 4 to 5) and the conductivity (ideal value 500 to 700 µS/cm). No other parameters need to be measured. This is one of the main benefits of the process which makes it particularly easy to use. Consumption of the process solution is closely linked to the design of the system and depends primarily on the carry-over, which is generally between 14 and 20 g/m^2. These figures may seem relatively high at first glance. However, when considered together with all the other factors, such as the low operating temperature, the short dwell time, the savings on waste water treatment and the ease of use, the production costs are similar to those for a typical iron phosphating process and significantly less than zinc phosphating.

Although the new pretreatment uses small quantities of trivalent chrome, it is currently the only process on the market which contains no hazardous substances. It meets all the requirements of the RoHS Directive (2002/95/EC) and the WEEE Directive (2002/96/EC). Initial use has shown that good adhesion properties can be achieved even in small, compact machines and in a combined conversion and cleaning process.

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