# Seeing chances in change

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**Switching to chromium(VI)-free corrosion protection systems involves a complex co-ordination process and the precise analysis of individual cases. However, in many cases it also leads to more high performance coatings. A positive side effect that is sure to be of interest to many industrial sectors.**

This July, when the so-called end-of-life vehicles directive (2000/53/EU) is implemented, the corresponding waste electrical and electronic equipment (2002/95/EU) directive will already have been in place for a year. Both of these EU directives prohibit the use of chemicals containing chromium(VI) in corrosion protection systems. The process of changing over in a situation of continuing production has either been completed or is in full swing. Even in the sectors of the motor vehicle industry where no such prohibition exists, such as for vehicles over 3.5 tonnes, many surface coating systems are being converted. On the one hand, there are recognised risks to both man and the environment. On the other hand, commercial considerations are also taken into account, as chromium(VI)-free products are required to be kept apart from components containing chromium(VI) throughout all stages of production, from manufacture to assembly. The consequences are higher costs for logistics and manufacturing due to the need to double production lines.

**The alternatives are already there**

In recent years - with the onset of galvanization - the range of offers in the galvanizing sector with regard to high-performance zinc alloying systems has expanded. Alongside this, passivation involving chromium(III) has assumed a dominant position. In this, modern analytical methods ensure that the end product is chromium(VI)-free (DIN 50993-1). The somewhat weaker corrosion protection of the new passivations in comparison to the former chromatings can be compensated by sealing. In addition, proven zinc flake coatings have been available for over 25 years which - as with the products of Dörken MKS-Systeme GmbH & Co. KG - have been chromium(VI)-free from the very beginning. In recent years both the zinc lamella systems and the galvanic coatings have been subjected to numerous round robin tests. In this, and in the current conversion process, it has been apparent that the switch to chromium(VI)-free coatings offers an opportunity to specifically incorporate additional performance characteristics, or to optimise existing ones. Temperature resistance and trouble-free assembly are the parameters most often influenced, together with chemical resistance and colouration. However, cases where the old coating technology can simply be replaced with the new are rare. In any case, there are changes for processors to adapt to.

**Higher layer thicknesses**

The additional sealing or the conversion of galvanic surfaces to zinc flake coatings involves an increase in layer thickness in the majority of cases. This has no effect on many components, as the changes concerned are in the µ region. However, for closer fits and threaded parts the respective tolerances should be observed in order to guarantee safe operation.

**Higher chemical resistance**
The additional sealing provides clear benefits here, as it can delay the effects of aggressive chemicals on the cathodic corrosion protection layers. Depending on the thickness of the layer, the systems are "sealed" and also offer increased resistance, in some cases, for example in the Kesternich test ($SO_2$ atmospheres), as well as higher resilience to common chemicals such as brake fluid, petrol, diesel or hydraulic oil.

**Higher temperature resistance**
Common yellow chromatings lose their corrosion protection characteristics at temperatures of over 70°C. This is a good example of how the pressure to change can lead to an improvement in characteristics. Because coatings consisting of passivated zinc or zinc alloys that have been sealed with a modern topcoat are able to withstand temperatures of up to 120°C. In contrast, the modern zinc flake systems provide protection when exposed to temperatures of up to 180°C for extended periods, without loss of corrosion protection. Both consistencies can be tested using VDA test sheets.

**Large range of colour tones**
With the organic, chromate-free topcoat it is possible to present a range of different colours. However, the preferred colour tones continue to be black and silver. With a few exceptions, chromium(VI)-free variants can be created for galvanic coatings in the standard range of colours.

**Friction factors for threaded connections**
This field displays the most significant changes. Standard testing to DIN EN ISO 16047 (= test with low speed against mostly hardened, ground steel backing runs) initially offers results comparable to those of the original state. However, practice shows strong deviations. The reasons for this are not

just the altered, now chromium(VI)-free zinc flake base coat, but the structure of the system as a whole and the way that it is installed. Improvements in corrosion protection are achieved for the most part with the use of silicate seals with integrated lubricant. The advantage: there is now only one work process, resulting in an age-resistant system independent of humidity and temperature. However, practice has shown that the silicate seal with integrated lubricant is unable to achieve the results previously realised with wax, especially on softer surfaces such as aluminium or castings, as well as on KTL coating. The cause of this is the hard $SiO_4$-compounds, which cannot adapt to soft or rough surfaces. A number of modifications have proved necessary here in recent years in order to achieve a suitable outcome. It is therefore advisable to pay close attention to the assembly layout and bearing surface, verifying these with tests where necessary. Caution is also recommended for galvanic coatings. If previously unlubricated surfaces (such as yellow zinc) are replaced with a sealed surface containing an integrated lubricant, this may reduce friction factors. At the same time, a preload force may be generated that is unsuitable for both the component and the joining element.

**Adhesives and threaded fasteners**

A number of threaded fasteners - especially those with short gripping lengths or a dynamic load - are secured against loosening with adhesives. As was previously the case, these adhesives do not adhere to lubricated surfaces particularly well. In the past this usually resulted in the lubricant being applied after the adhesive. The forthcoming amended DIN 267 T 27 should take this into consideration. In practice, surfaces without integrated lubricant should be used.

**Summary**

Industry provides chromium (VI)-free coatings with comparable characteristics to their chromium(VI)-based precedents. However, the switch to chromium(VI)-free brings with it additional work. On the other hand, this approach leads to new problem solutions with clearly better characteristics, from which other industrial sectors can also benefit in addition to the automotive industry. However, the transition cannot be effected in a blanket 1:1 form. Continuous engagement between users and corrosion protection suppliers is necessary in order to find the right solution for each respective case.