RoHS: Cr(VI)-free coatings compared

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EU directive 2000/53/EC (RoHS) is in force, and since July 1, 2007, use of electroplated coatings containing chromium(VI) for the purpose of providing corrosion protection is now also prohibited in part of the automobile industry. Alternative protective coatings are also increasingly in demand in the mechanical engineering sector. New coatings compliant with the directive can already be found on quite a number of components such as APSOfluid® cutting ring couplings from Angst+Pfister. The following article compares common electroplated coatings and their performance characteristics from a practical perspective.

After numerous years of using hexavalent chromium to coat steel parts for corrosion protection purposes, replacement substances are now being sought. The aim is to avoid using hazardous materials and to enable safe recycling at the end of products' useful lives. In the future, refraining from using chromium(VI) will not only be mandatory for passenger cars and commercial vehicles with total weights of up to 3.5 tons, but will become a matter of course throughout industry. The electroplating industry has long started to transform its processes accordingly.

High demands

The surface protection that has been used for steel parts in most cases until now is based on an electroplated zinc layer of 8–12 µm and a chromate layer of around 0.3 µm. This type of coating was of proven value for parts exposed to mechanical wear, not least because of its proverbial self-healing effect. Moreover, surfaces protected this way showed good results in DIN 50021-SS salt spray tests (100 hours, against white rust). Every alternative coating has to stand up to this test.

Zinc with passivation and sealing

The most obvious and already often used Cr(VI)-free surface protection is itself based on a zinc layer. In place of a chromate layer, passivation is applied. In addition, the surface is sealed. In the absence of chromium(VI), this surface protection lacks the self-healing effect. The effective performance depends on the nature and thickness of the sealing.

APSOfluid® zinc-nickel-plated straight cutting ring couplings

Cutting rings also available with precision seals

Hose fittings with Cr(VI)-free passivated and sealed galvanizing

Zinc-nickel as a new basis

A chemically more resistant zinc-nickel alloy is used as a base layer instead of zinc. Here, passivation and subsequent sealing is also applied.

Even without the self-healing effect, the treated components maintain very high chemical resistance, even after handling and assembly.

Comparison of corrosion resistances

Galvanization coupled with subsequent passivation and sealing can produce corrosion protection that is at least comparable to the previous method of galvanizing and yellow chromating, as Figure 1 clearly shows. However, the self-healing effect is absent.

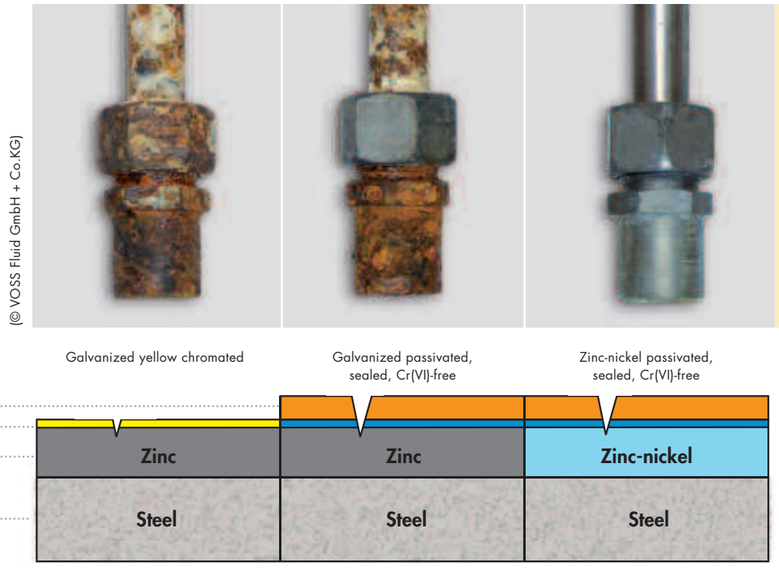
Application-specific suitability

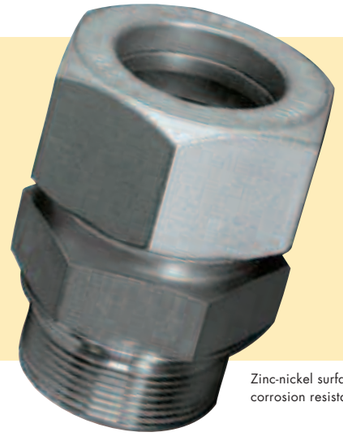
For use in vehicle production where, among other things, passing the rigorous salt spray test is essential, a more resistant zinc-nickel base layer provides the best conditions. VOSS Fluid GmbH cutting ring couplings from the Angst+Pfister product range are the only ones of their kind to be equipped with this type of Cr(VI)-free surface protection. Here, they are the solution of first choice.

Good corrosion protection is also achieved with zinc as a base layer coupled with passivation and subsequent thick film sealing. However, performance under adverse conditions depends largely on the nature of the passivation, the sealing thickness and the selected process steps. In most cases, carefully applied surface protection of this kind will be adequate in mechanical engineering.

Furthermore, there is still the alternative of using stainless steel parts. Even less expensive chromium-nickel grades such as W.-No. 1.4301 are fully sufficient for preventing corrosion. This variant is preferred for screw-type hose clamps where the bands and worm screws undergo high mechanical strain.

Figure 1: Comparison of layer composition of the different surfaces





Zinc-nickel surface enhances corrosion resistance

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