Chrome (III) – From Planning to Mass Production

Decorative chrome coatings using trivalent chrome are a valuable alternative to hexavalent chrome compounds in terms of both appearance and corrosion protection, as this current example from industry shows.

The German electroplating company Willy Remscheid produces around 30 million die cast zinc components and one million aluminium parts every year. A total of 98 percent of these parts are given a chrome coating. In the light of the imminent ban on chrome (VI) and the growing demand for chrome (III) finishes, the company decided in 2018 to add trivalent chrome coatings to its range of services.

A project plan with a schedule was drawn up which included the key tasks such as inviting tenders, ordering, application, approval and providing samples. The aim was to take the project from the planning phase through to volume production in nine months. Despite a significant delay during the approval process, Willy Remscheid was able to complete the project on schedule.

During the selection of the chemical supplier, the company focused on four criteria:

1. The supplier's experience with chrome (III)
2. Acquiring the approval of major customers for the products
3. The availability of staff and delivery times
4. The costs

Sulphate-based trivalent chrome

The contract was ultimately awarded to the chemical manufacturer HSO, which supplies EcoChrome III, a sulphate-based trivalent chrome process that uses electrolysis to produce decorative coatings. The appearance of these coatings is very similar to those deposited with hexavalent chrome electrolytes. The electrolyte operates with anodes made from expanded titanium and covered with an insoluble iridium mixed oxide. As in the hexavalent chrome process, it is not possible to use chrome anodes. For this reason, the chrome is only supplied and deposited by the solution.

In contrast to the hexavalent chrome electrolytes, an ion exchanger with a resin that is sensitive to metal is needed to clean the electrolyte, because otherwise metal contamination carried over into the electrolyte would be incorporated into the chrome coating. The reason for this lies in the deposition mechanism. While in the case of

The visual difference between the chrome (III) coating (left) and the chrome (VI) coating (right) only becomes clear in a direct comparison.
The trivalent chrome coating does not have the familiar blueish tint.

Working conditions

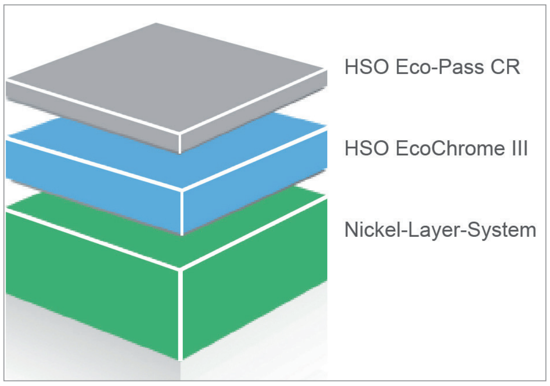
Parameter	Range	Optimum
Temperature	52 – 60 °C	57 °C
Current density	5 – 9 A/dm^2	7 A/dm^2
pH value	3.2 – 3.8	3.6
Specific density	1.2 – 1.25	1.225
HSO EcoChrome III Salt	260 – 290 g/l	280 g/l
HSO EcoChrome III Part A	8 – 16%	11%
Chrome	6.2 – 12.5 g/l	8.5 g/l
HSO EcoChrome III Whitener	8 – 15 ml/l	12 ml/l
HSO EcoChrome III Booster	1.5 – 8 ml/l	5 ml/l
HSO EcoChrome III Complexor	1.6 – 2.2 xCr	2 xCr
Surface tension (bubble pressure tensiometer at 60°C)	40 – 65 mN/m	45 Mn/m

Table 1 > Some of the parameters of the trivalent chrome process.

hexavalent chrome electrolytes the chrome is deposited from an anion, the trivalent chrome electrolytes use a cation. This means that other cations present in the solution are also deposited, unless they are first removed by an exchanger.

Good scattering power and corrosion resistance

The chrome (III) electrolyte has a much greater scattering power in the case of high-gloss coatings thinner than 0.5 µm. The deposition speed is between 0.05 and 0.08 µm/min and the chrome content is between 6 and 12.5 g/l, depending on the deposition speed and scattering power required. In a chrome (VI) process, the chrome content ranges from 250 to 400 g/l. Other benefits of the trivalent chrome electrolyte include good metal distribution, soft complexing agents, no harmful aerosols or partially fluorinated surfactants and simpler waste water treatment.
In order to achieve high levels of corrosion resistance, trivalent chrome coatings need to be passivated. This takes the form of an electrolytic passivation process that is carried out in the machine after electroplating and involves creating a layer only a few nanometres thick on the surface. The passivation process changes the electrochemical potential of the chrome coating and seals the surface. As a result, the coating meets the high standards required by the automotive industry. The trivalent chrome process is more expensive and Willy Remscheid estimates that this leads to a price increase of between 8 and 14 percent, depending on the type of component.
Training courses for coating with a trivalent chrome electrolyte were held in cooperation with the supplier on the company's premises and at the supplier's site.



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Impressive appearance

When Willy Remscheid presented the trivalent chrome coated components to some of its customers, most of them were surprised by the quality of the finish. Hardly any of them noticed the slight change in appearance. The difference only becomes clear in a direct comparison between chrome (VI) and chrome (III) coatings. The trivalent chrome coating does not have the familiar blueish tint. //

CASS test	48 h OK
NSS test	480 h OK
Russian mud test	OK
Ni release (EN 1811)	< 0.03 mg/l

Table 2 > Requirements met by the trivalent chrome coating after passivation.

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