
Chromitierung - Chromiting

the New Passivation for Zinc Free of Chromium(VI)

Features, Process and Economy

Dr. Rolf Jansen and Patricia Preikschat, SurTec GmbH, Zwingenberg, Germany

State of the Art for Chromium(VI)

DIN 50961 for yellow chromates on zinc:	72 h	(barrel)
	96 h	(rack)
Reached in practice are roughly, with ...	to first attack	DIN 50021
...yellow chromate on zinc:	ca. 100 h	(barrel)
	ca. 200 h	(rack)
...yellow or black chromate on zinc/iron	200-400 h	(rack)
...yellow or black chromate on zinc/nickel	300-600 h	(rack)

Additional, New Requirements

- colour metallic/colourless or black
- heat resistant
 - > 120 (engine room), 150-200 (brake systems), 210 °C (stress relieve)

Not fulfilled by actual systems, consequently *Zinc Alternatives* are released.

Mechanism

Zinc provides on steel a cathodic protection against base metal corrosion.

Parameters: layer thickness, metal distribution, trace metals (e.g. alloys)

Zinc itself is protected by the **passivation** against corrosive attack.

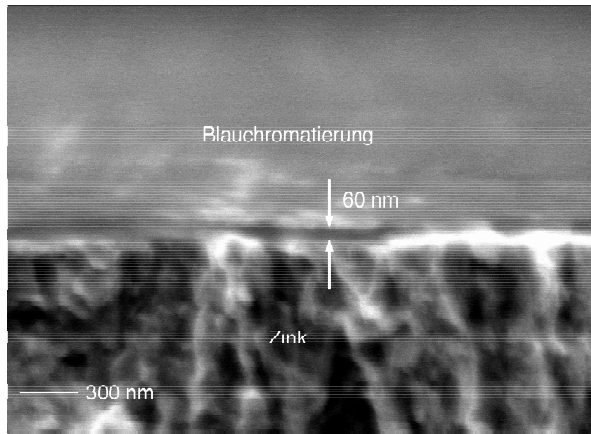
Parameters: thickness (barrier effect), chemical composition

A **post treatment** stabilises and reinforces the passivation layer or builds an additional protection layer (sealer).

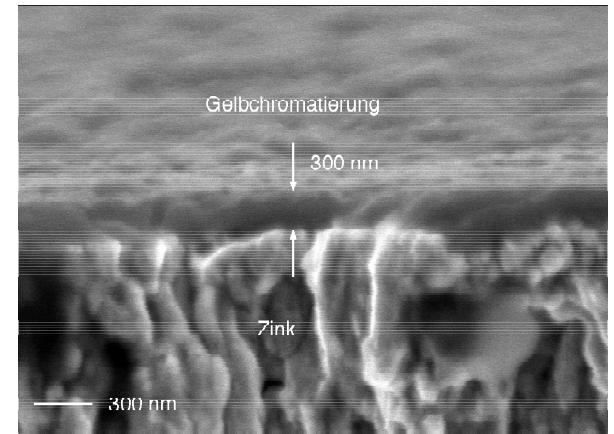
The relation between layer thickness and corrosion protection can be shown by the difference between blue and yellow chromate:

Type	Cr(VI) in the passivation layer in mg/m	layer thickness in nm	corrosion protection, neutral salt spray test in hrs to first attack
Blue (trivalent)	0	25-80	20-40
Yellow	80-220	250-500	200-300
Olive	300-400	1000-1500	400-500
Black	80-400	250-1000	150-300

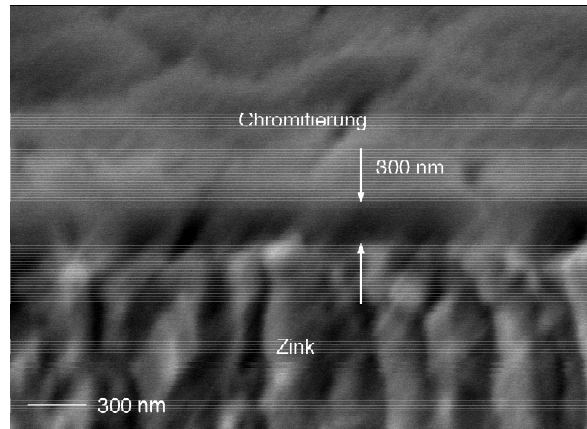
Chromiting is as thick as a Yellow Chromate layer.



edge of a zinc plated and trivalent **blue passivated** steel sheet at a magnification of 40,000



edge of a zinc plated and hexavalent **yellow passivated** steel sheet at a magnification of 40,000



edge of a zinc plated and trivalent **chromited** steel sheet at a magnification of 40,000

Chromiting

Suited for Barrel and Rack

The corrosion behaviour of **barrel parts** is strongly influenced by their geometry.

Results to first attack:

70-100 h with sharp edged parts
200-300 h with well rolling parts

In case of Chromiting, the good corrosion protection is not made by soluble (repassivating) compounds, but by its particularly hard layer, which - during formation - has only a very short gel phase.

Rack parts generally are reaching very good values > 300 h until first attack.

Heat Resistance of Chromiting

Laboratory enquiries showed that the corrosion behaviour is virtually not influenced up to 215 °C. At higher temperature, zinc starts to evaporate.

A **screw manufacturer** obtained on his parts:

240 h to first attack
after 24 h at 220 °C

Very rough **cast iron** (brake parts) was tested in comparison to a yellow passivation.

Explanation of the subsequent transparencies:

1. no heat	2. 1 h at 120 °C
3. 1 h at 150 °C	
4. 1 h at 200 °C	5. 2 h at 200 °C

Photographies each after 240 hours of neutral salt spray according DIN 50021

Post-Treatment on Chromiting

Sealers (dispersions of organic polymers) such as SurTec 552 or SurTec 555 raise the corrosion protection until first attack about 100 h, and still much more they slow down the progress of the corrosion in expanse.

Example:

screws M8 x 25, zinc plated and chromited

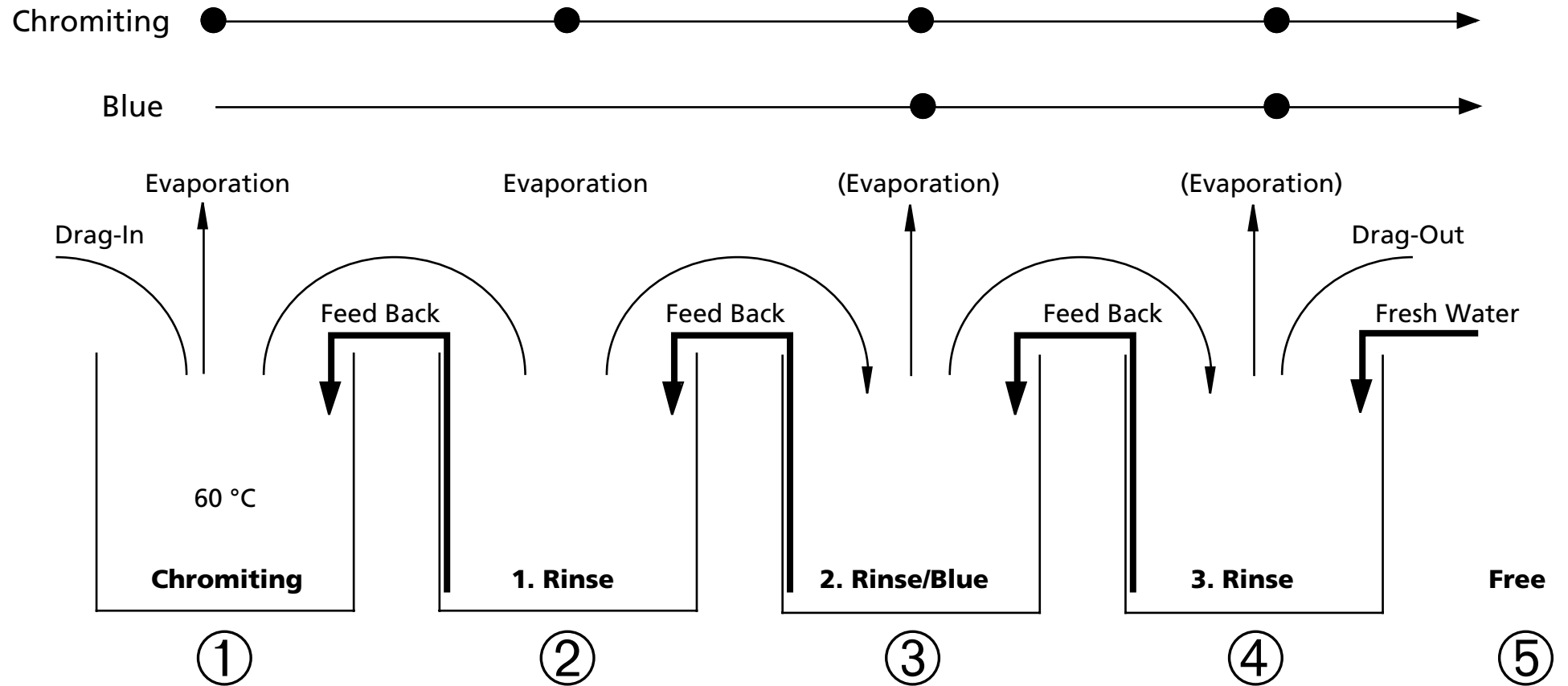
280 h to first corrosion
400 h to 5 %

screws M8 x 25, zinc plated, chromited and sealed

380 h to first corrosion
800 h to 5 %

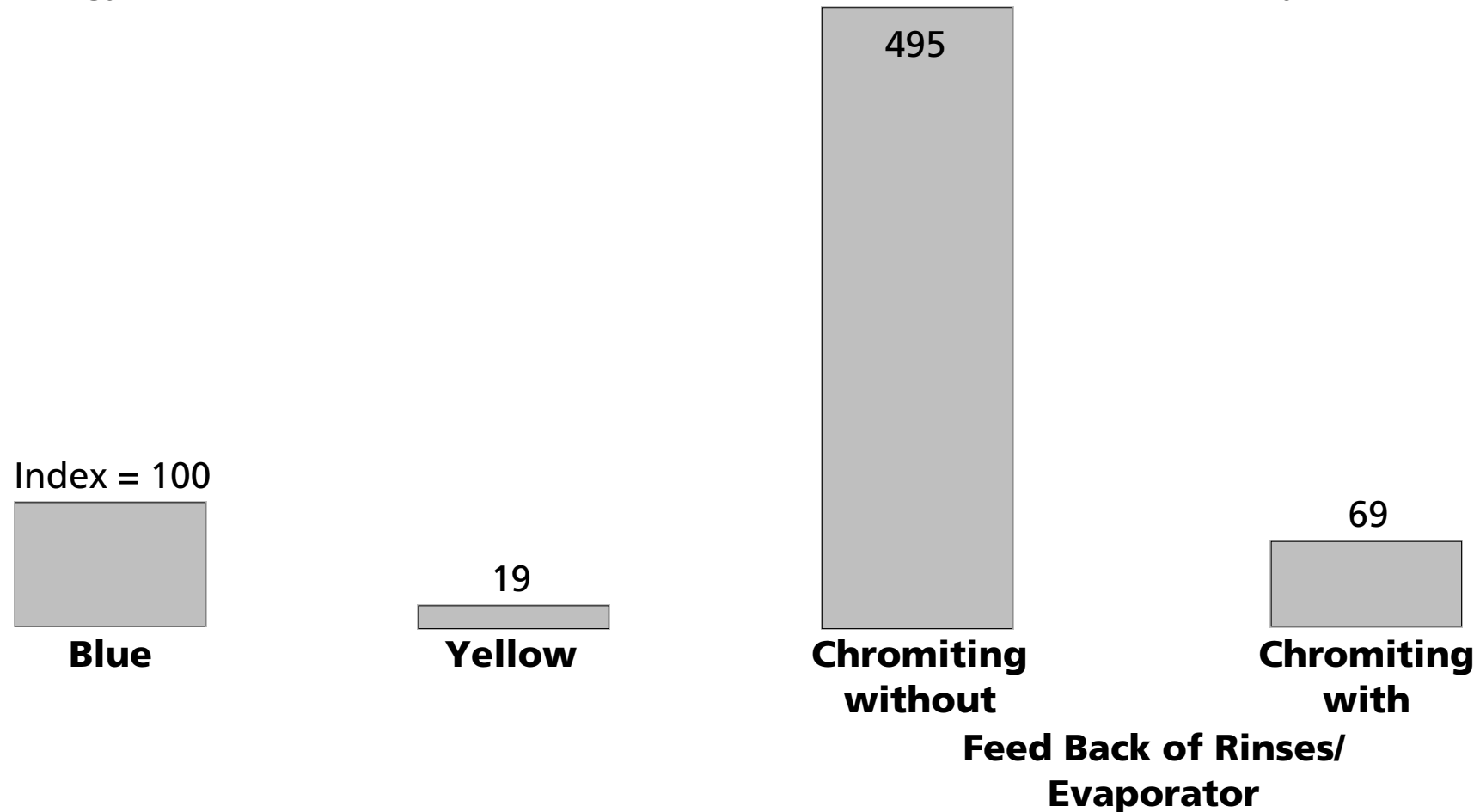
Heat Resistance: all organic sealers get brown > 200 °C, thus are not suited for parts that need degassing resp. have to be applied after heat treatment. For temperatures between 100 and 200 °C, SurTec 555 is the recommended sealing.

Line Scheme



Old Processes: Yellow Rinsing Yellow Blue Rinsing Blue Flow Rinse

Example: Barrel line, 1500 l per tank, 8 barrels per hour, drag-out 3 l/barrel, with all chemistry and energy costs (evaporator), waste water costs (chromium(VI) reduction) not yet included.



This means, Chromiting without Feed Back Rinse costs as much as Blue Chromate plus Sealer, and Chromiting with Feed Back Rinse costs about the same as a normal post treatment.

Future of Hexavalent Chromium

⇒ EU-Directive „End of Life Vehicles“ (final status)

- duty to avoid, recycle or re-use of rubbish
- who causes has to care
- instructions for the dismantling, re-use and recycling of car parts
- vehicles for the European market must be free of hexavalent chromium (< 2 grams per car) after 1.7.2003
- last user should be able to dispose his vehicle correctly and free
- destruction certificate as a proof

Metallic chromium and chromium(III) are NOT banned according this draft; chromium(VI) as such is to avoid in cars for recycling.

Other Colours

Is there a Black Chromiting?

- black layers on zinc-iron are possible with a variation of Chromiting
- black layers on zinc-cobalt are possible according the same principle, but less uniform due to the uneven cobalt distribution
- for zinc-nickel, a black Chromiting is not yet available; the natural colour of Chromiting on zinc/nickel is dark-blue to light yellowish-green

Dyes

- coloured layers can be reached (blue, yellow, pink are already tested)
- black dyes are too weak in colour to obtain an opaque colouring