

Processing of Trivalent Bluepassivations to reach longer Service Lives

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August 1995
2. edition*

In the running process of trivalent bluepassivations, the zinc and the iron content are rising nearly linear. The limiting factor of the service life of a blue passivation normally is the iron content. In rack processes without steps to increase the service life (see Technical Letter No. 4), the blue passivations usually do not get so old that zinc is accumulated too much, causing problems. Only well controlled rack baths or barrel processes can reach long service lives and zinc contents up to 20 g/l.

Trivalent blue passivations as SurTec 660, 661, 662 and 664 can be used without any loss of quality up to very high zinc contents, which is described in this Technical Letter.

* New in the 2. edition includes hints about the influence of temperature

1 Passivation of Zinc

During the chromating, in the first step elementary zinc is dissolved due to the attack of acid. Consequently, the pH at the surface of the part rises to values at which chromium(III)/zinc oxide precipitates forming the passivation layer. The speed of formation is accelerated if zinc already is dissolved in the passivation bath. At high zinc contents, the parts will be overchromated easily, which is visible as a yellowish passivation layer. This effect also occurs at higher bath temperatures (e.g. in summer time).

Compared to the yellowish passivation layer caused by dissolved iron (see SurTec Technical Letter 4), this zinc or temperature effect can be removed easily: choose shorter application times and/or decrease the chromium content of the passivation.

2 Process Handling

2.1 New Make-Up

A new make-up is done at 5 Vol% (at temperatures lower than 17 °C at 6 Vol% preferably, at temperatures of about 25 °C at 4 Vol% preferably) using one of the concentrates SurTec 660, 661, 662 or 664 (in the following they are named as SurTec 66x) and -if necessary- with 0.05 Vol% iron inhibitor SurTec 660 A. The pH has to be corrected with nitric acid to 1.8. For an easy and exact pH correction we recommend the pH table in the annex..

2.2 Maintenance

The addition of concentrate per day depends on the passivated surface and the drag out. If possible, the dosage should be done not once a day but in small portions all over the day. For barrel processes it is preferable to add continuously (regulated by the barrel frequency) a premixed maintenance solution, containing the passivation concentrate and nitric acid.

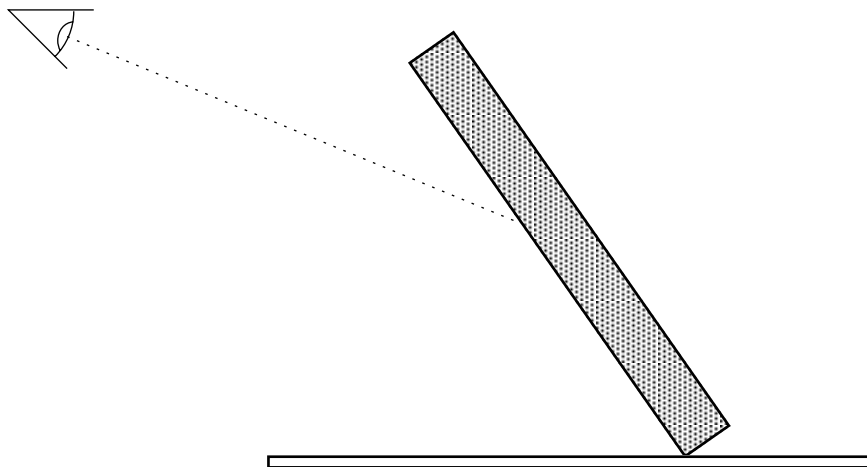
Under equal conditions (concentration, pH value, application time), the chromate layer will get thicker with zinc content or temperature rising, finally a strong over-chromating results. To prevent faults in the chromating layer, the bath concentration has to be decreased with rising zinc content.

But also the temperature has to be considered. The following formula helps to estimate the necessary concentration:

$$\text{necessary concentration in Vol\%} = 5 - \sqrt{\text{zinc content in g/l.5}} - \sqrt{\text{temperature in } ^\circ\text{C} - 20.5}$$

A more reliable method to add the concentrate, is the dosage according the appearance of the parts. The iridescent colour of the chromate layer corresponds to the layer thickness and can therefore be used as a parameter to adjust the bath concentration:

Put a treated part slanting onto a white paper and look at it at an angle (see the following sketch). The visible colour effects, their causes and the necessary action are summarised in the table below.



iridescent colour	cause	necessary action
golden	chromate layer is very thin	rise the concentration and the application time
light red - golden	chromate layer is thin	rise the concentration
light red - blue	chromate layer is a little bit thin	rise concentration or temperature slightly
blue	chromate layer is optimal	no action
light green - blue	chromate layer is a little bit thick	shorten application time slightly
light green	slight overchromating	shorten application time, evtl. dilution of the bath
light green - yellow	strong overchromiting	dilution of the bath

Other colour effects can be caused by contamination of heavy metals in the bath. Especially iron is easily dissolved into the bath, if some parts are not totally plated with zinc, or if parts are fallen into the bath. Without masking the iron, a strong yellow colour can occur (beginning at ca. 500 ppm iron), which can be mistaken to be an overchromating. To distinguish these both effects, some trials apart from the plating line in a bucket filled with the present passivation, using shorter application times can help:

- If there is no yellow colour at shorter application times, it was caused by overchromating and not by iron impurities. The necessary action is described in the table above.
- If the iridescent colour is golden or light red to golden, the application time was too short and the chromating layer is too thin (see in the table). The trial has to be repeated with a little longer application time.
- If the (not iridescent, but real) yellow colour occurs also at short application times, and the iron content was analysed to be higher than 250 ppm (e.g. iron test paper Merckoquant from Merck), it can be tried to mask the iron, using citric acid (as described in SurTec Technical Letter 4). If the yellow colour stays the same after adding the citric acid into the bucket, a new passivation bath has to be made up.

3 Conclusion

The presence of iron is not the only reason for a yellow appearance of a blue passivation. A high zinc concentration or a high bath temperature of the passivation bath lead to a faster formation of the chromating layer. To prevent a yellow aspect of the passivated parts caused by overchromating, the bath concentration (Cr-III content) has to be decreased with a rising zinc content or rising temperature (for example in summer time). Thus, the desired concentration of the blue passivation decreases with the age of a bath. This has to be considered for the dosage of concentrate after the analysis of a passivation bath. A dosage according to the aspect of the parts, which is recommended in this Technical Letter, automatically leads to an optimized bath condition.