

SurTec® 843

Decorative Highly Bright Nickel/Iron Process

Properties

- produces highly bright, well levelled and ductile Ni/Fe deposits with low inner tension (same quality as it can be achieved with bright nickel processes)
- reduced nickel content in the layer, so low consumption of nickel anodes
- good economical efficiency
- ideal basis layer for decorative chromium plating using the trivalent chromium process (SurTec 876) or the hexavalent chromium process (SurTec 871)

Application

SurTec 843 can be used in rack or barrel application. The process SurTec 843 includes the following products:

- SurTec 843 I Carrier is responsible for the equal metal distribution and is the basic for the brightener
- SurTec 843 II Brightener brings the desired brightness and the levelling to the layer together with SurTec 843 III
- SurTec 843 III Leveller is responsible for the levelling (together with SurTec 843 II)
- SurTec 843 C Complexing Agent keeps iron(III) in the solution and produces the special Ni/Fe alloy layers
- SurTec 850 LCD Purifier effects a constant bright precipitation in low current density areas
- SurTec 850 L Wetter Air Agitation is necessary to wet the surface and to avoid pores in the layer

make-up values:

nickel sulfate · 6 H ₂ O	120 g/l	(100-150 g/l)
nickel chloride · 6 H ₂ O	120 g/l	(90-130 g/l)
boric acid	45 g/l	(43-50 g/l)
SurTec 843 I Carrier	30 ml/l	(25-35 ml/l)
SurTec 843 II Brightener	1 ml/l	(0.5-1.0 ml/l)
SurTec 843 III Leveller	25 ml/l	(20-30 ml/l)
SurTec 843 C Complexing Agent	10 g/l	(8-12 g/l)
SurTec 843 R Reducing Agent	if necessary	
SurTec 850 LCD Purifier	if necessary	(0.1-0.5 ml/l)
iron(II) sulfate · 7 H ₂ O	20 g/l	(15-50 g/l)
SurTec 850 L Wetting Agent	2 ml/l	(2-3 ml/l)

analytical values:	nickel	55 g/l	(45-65 g/l)
	iron	4 g/l	(3-10 g/l)
	chloride	33 g/l	(27-39 g/l)
	boric acid	45 g/l	(43-50 g/l)

make-up:	Steps for make-up: <ol style="list-style-type: none"> 1. Into a separate tank fill in 1/3 of the required deionised water. 2. Heat up to at least 60 °C. 3. Add nickel salts and boric acid, stirring well. 4. Add 5 g/l active carbon and stir for 2 hours. 5. Allow it to settle down and filter the solution into the clean plating tank. 6. Fill up with deionised water nearly to the final volume. 7. Work-in the electrolyte for 4 hours at 0.4 A/dm². 8. Plate a test panel at 4 A/dm² for 15 minutes. If this is ductile enough add the additives, if not continue work-in further. 9. Add the calculated amounts of SurTec 843 III, SurTec 843 C, SurTec 850 L, SurTec 843 I and SurTec 843 II under low agitation. 10. When all additives are dissolved, add iron(II) sulfate.
temperature:	60 °C (55-65°C)
pH-value:	3.2 (3.0-3.5) adjust with sulfuric or hydrochloric acid, increase by plating
cathodic current density:	4 A/dm ² (2-10 A/dm ²)
anodic current density:	1.5 A/dm ² (1 - 5 A/dm ²)
anodes:	high pure nickel anodes or titanium baskets with nickel pellets; and baskets with pure iron pellets (not alloy iron)
ratio:	ratio Ni baskets : Fe baskets = 5 : 1 to 8 : 1
agitation:	air agitation and, if desired, additionally: rack agitation (approx. 1.5 m/min) barrel rotation (approx. 4-8 r/min)
tank material:	steel with acid-resistant coating (PVC, PP, technical rubber)
filtration:	required; continuously with 1-3 times the total bath volume per 8 h
heating:	required; made of acid resistant material
exhaust:	required for workers' protection
hints:	<p>To keep constant the iron concentration, a regular control of the Ni-anode and the Fe-anode area is necessary. pH-control is one of the key points to keep the iron content inside the desired range; lower pH-values will lead to increasing iron concentrations in the bath.</p> <p>Nickel pellets and iron pellets are not allowed to be in the same basket. Anode bags of PP can be used, they had to be 5-10 cm larger than the anode baskets.</p> <p>During periods of production turn off the air agitation to avoid iron oxidation in the bath.</p> <p>Control all other possible sources of iron oxidation and eliminate them, if necessary:</p> <ul style="list-style-type: none"> - anodic polarisation - pump filter leakage, air inlet through the filters - nickel chloride concentration below 45 g/l - anode baskets not completely full of pellets - air agitation during production stop

recommended process sequence for plating steel parts:

1. hot degreasing
emulsifying: SurTec 188 + SurTec 415
demulsifying: SurTec 188 + SurTec 089
2. hydrochloric acid pickling with SurTec 424
3. anodic electrolytical cleaning SurTec 171
4. neutralisation SurTec 481
5. Highly Bright Nickel/Iron Process SurTec 843
6. Decorative Chromium Process SurTec 876 or SurTec 871
7. recovering rinse (Cr)
8. rinse
9. drying

Between each step, there has to be rinsed. The rinsing methods have to be adapted to the plating line.

Technical Specification

(at 20 °C)	Appearance	Density (g/ml)	pH-value (conc.)
SurTec 843 I	liquid, colourless, clear	1.036 (1.02-1.05)	4 (3.5-4.5)
SurTec 843 II	liquid, yellowish, clear	1.012 (1.00-1.02)	4 (3.5-4.5)
SurTec 843 III	liquid, colourless, clear	1.020 (1.01-1.03)	4 (3.5-4.5)
SurTec 843 C	powder, white-yellowish	0.900 (0.77-1.04) kg/l	6-9 (at 100 g/l)
SurTec 850 L	liquid, yellowish, clear	1.003 (0.99-1.02)	4.2 (3.5-6)
SurTec 850 LCD	liquid, colourless-yellowish	1.008 (1.00-1.01)	3-7
SurTec 843 R	powder, white	0.880 (0.83-0.93) kg/l	2.2 (at 10 g/l)

Maintenance and Analysis

Check and adjust the pH-value regularly.

Analyse and adjust the concentration of nickel, iron (II + III), chloride and boric acid regularly.

Dosage of the additives according Ampère-hours is possible.

Sample Preparation

Take a sample at a homogeneously mixed position. Let it cool down to room temperature. If the sample is turbid, let the turbidity settle and decant or filter through a fluted filter.

Nickel – Analysis by Titration

reagents: 0.1 mol/l EDTA (Titrplex III)
ammonia solution (conc.)
indicator: murexide

procedure: 1. Pipette 1 ml bath sample into a 250 ml Erlenmeyer flask.
2. Dilute to approx. 100 ml with deionised water.
3. Add 12 ml ammonia solution.
4. Add a spatula tip of indicator.
5. Titrate with 0.1 M EDTA from yellow to violet.

calculation: consumption in ml · 5.87 = g/l nickel

correction: rise by 1 g/l = addition of 4.8 g/l nickel sulfate · 6 H₂O
or: 4.1 g/l nickel chloride · 6 H₂O

Chloride – Analysis by Titration

- reagents: 0.1 N silver nitrate solution
indicator: potassium chromate solution (5 %)
- procedure: 1. Pipette 10 ml bath sample into a 250 ml Erlenmeyer flask.
2. Dilute to approx. 150 ml with deionised water.
3. Add 1 ml indicator (the pH-value of the solution has to be between pH 6.5 and pH 10.5).
4. Titrate with 0.1 N silver nitrate solution from yellow to brown.
- calculation: consumption in ml · 3.54 = g/l chloride
- correction: rise by 1 g/l = addition of 3.0 ml/l hydrochloric acid (30 %)
or: 3.4 g/l nickel chloride · 6 H₂O

Boric Acid – Analysis by Titration

- reagents: 0.1 N NaOH solution
EDTA sodium salt
mannitol
NaOH solution (15 %)
- procedure: 1. Pipette 2 ml bath sample into a 250 ml Erlenmeyer beaker.
2. Dilute with approx. 50 ml deionised water.
3. Add 2-4 g EDTA salt.
4. Adjust the pH-value to pH 7.9 with 15 % NaOH solution.
5. Add so much mannitol to the **clear** solution, until the pH is not changing more than 0.1 points (approx. 10 g).
6. Titrate with 0.1 N NaOH solution to pH 7.9 again.
- calculation: consumption in ml · 3.09 = g/l boric acid

Iron(II) – Analysis by Photometry

- equipment: spectrophotometer or
filterphotometer with filter 301 nm
100 ml beaker, 250 ml volumetric, 1 ml pipette, heater,
1 cm quartz glass cuvette
- reagents: sulfuric acid (conc. p. a.)
H₂O₂ (approx. 35 % p. a.)
iron stock solution with 1 g/l Fe:
Fill 4.978 g FeSO₄ · 7 H₂O in a 1000 ml volumetric flask, add some deionised water, add 20 ml HCl conc. and fill up to the final volume.
- procedure: Plot of the calibration curve (quarterly):
Fill in every 100 ml beaker 1 ml basic electrolyte without iron and add the following volumes of the iron stock solution:
0 ml, 1 ml, 2 ml 3 ml, 4 ml, 5 ml
In each beaker:
1. Fill in 0.5 ml sulfuric acid (conc. p. a.).
2. Add 1 ml H₂O₂.
3. Dilute with deionised water to 70 ml.
4. Boil it for 30 min (do not evaporate the volume under 25 ml).
5. Cool down to room temperature and transfer the standard solutions into 250 ml volumetric flasks (wash the beakers a few times with small amounts of deionised water).
6. Fill up with deionised water to the final volume.

Fill some ml of every solution in a quartz glass cuvette (1 cm) and measure it in the photometer at 301 nm. Plot the extinction against the concentration in a diagram. With this calibration curve the iron contents of the samples can be analysed.

Sample measurement:

1. Pipette 1 ml filtrated bath sample into a 100 ml beaker.
2. Add 0.5 ml sulfuric acid.
3. Add 1 ml H₂O₂.
4. Dilute with deionised water up to 50 ml.
5. Heat up for 30 min.
6. Cool down and transfer it quantitatively into a 250 ml volumetric flask.
7. Fill up to the final volume.
8. Measure it in a quartz glass cuvette in the photometer at 301 nm.
9. Determine the iron content by using the calibration curve.

possible errors:

- Bath turbidity simulates a higher concentration, therefore the sample should be filtrated.
- Calibration curves are specific for the instrument being used and must be plotted accordingly.

Iron(III) – Analysis by Photometry

equipment: see Iron(II)-analysis

reagents: see Iron(II)-analysis

procedure: Sample Measurement:

1. Pipette 1 ml filtrated bath sample into a 250 ml measuring flask.
2. Add 0.5 ml sulfuric acid.
3. Fill up the measuring flask und mix well.
4. Measure in the photometer at 301 nm.
5. Determine the iron content by using the calibration curve (same as for the iron(II) determination).

If the Iron(III) values are under 1g/l, make a correction of the value:

$$\text{Fe content} + 0.12 = \text{Fe(III) content in g/l}$$

possible errors:

- Bath turbidity simulates a higher concentration, therefore the sample should be filtrated.
- Calibration curves are specific for the instrument being used and must be plotted accordingly.

Consumption and Stock Keeping

The consumption depends heavily on the drag-out. To determine the exact amounts of drag-out, see [SurTec Technical Letter 11](#). The following values per 10,000 Ah can be taken as estimated average consumption:

SurTec 843 I	1-3 l
SurTec 843 II	1-3 l
SurTec 843 III	1-2 l
SurTec 843 C	0.2-0.3 kg
SurTec 850 L	approx. 0.5 l

In order to prevent delays in the production process, per 1000 l bath the following amounts should be kept in stock:

SurTec 843 I	50 kg
SurTec 843 II	50 kg
SurTec 843 III	50 kg
SurTec 843 C	25 kg
SurTec 850 L	25 kg
SurTec 850 LCD	25 kg

Product Safety and Ecology

The safety instructions and the instructions for environmental protection have to be followed when handling the products in order to avoid hazards for people and environment. The EU Material Safety Data Sheets contain explicit details for this.

The following hazard designations and classifications into water hazard classes (WHC) have to be taken into account:

<i>product</i>	<i>hazard designation</i>	<i>water hazard class</i>
SurTec 843 I	-	WHC 1
SurTec 843 II	-	WHC 1
SurTec 843 III	-	WHC 1
SurTec 843 C	-	WHC 1
SurTec 850 L	Xn - Harmful	WHC 1
SurTec 850 LCD	-	WHC 1
SurTec 843 R	-	WHC 1

Warranty

We are responsible for our products in the context of the valid legal regulations. The warranty exclusively accesses for the delivered state of a product. Warranties and claims for damages after the subsequent treatment of our products do not exist. For details please consider our [general terms and conditions](#).

Further Information and Contact

In our forum, you can discuss topics of the surface technology:

<http://forum.SurTec.com/>

If you have any questions concerning the process, please contact your local technical department: <http://SurTec.com/International.html>

Trouble Shooting

problem	possible cause	remedy
burnings	a) current density is too high	lower the current density
	b) agitation is insufficient	improve the agitation
grey or cloudy deposition in the lcd	a) metal impurities in the bath	add SurTec 850 LCD in steps of 0.1 ml/l (check each step by Hull cell test before) attention: overdosage can effect faults in the following chromium plating
	b) concentration of the brightener is too low	add SurTec 843 II in steps of 0.1 ml/l (check each step by Hull cell test before)
low leveling	a) pH-value too low	rise the pH-value to 3.2-3.5
	b) concentration of the leveller is too low	add SurTec 843 III in steps of 1 ml/l (check each step by Hull cell test before)
	c) concentration of the brightener is too low	add SurTec 843 II in steps of 0.1 ml/l (check each step by Hull cell test before)
too low iron content in the layer	a) iron content in the bath is too low	analyse and adjust to 5 g/l iron increase the surface of the iron anodes, respectively decrease the pH value slightly (to pH 3.2-3.0) to speed up the dissolving of iron
	b) concentration of the complexing agent is too high	work out the complexing agent; increase the iron content temporary to > 5 g/l
too high iron content in the layer	a) iron concentration in the bath is too high	analyse and adjust to 5 g/l iron increase the surface of the nickel anodes, respectively increase the pH value slightly (to pH 3.3-3.5) to slow down the dissolving rate of iron
	b) concentration of the complexing agent is too low	add SurTec 843 C