SurTec® 717
Alkaline Zinc/Nickel Electroplating Process (Electrolyte based on Sodium)

Properties

- tolerates higher temperatures
- superior metal distribution
- produces Zn/Ni alloy deposits containing 12-15 % nickel
- produces alloy layers with a very uniform composition in the current density range from 1 to 4 A/dm^2
- produces a fine-grained, bright and homogenous surface appearance
- alkaline process with high current efficiency (50-60 %)
- suited for rack application
- IMDS-number: 736126

Application

SurTec 717 is applied in rack processes and includes the following products:

- SurTec 717 I Carrier controls the metal distribution and the alloy composition
- SurTec 717 II Brightener supplies the brightness and is dosed optional and only if needed according to Hull cell test
- SurTec 717 LCD Booster is used as a secondary brightener and works at low current density
- SurTec 717 Ni B Nickel Solution for maintenance contains 100 g/l nickel as well as complexing agent and is necessary to keep the nickel concentration constant
- SurTec 717 Ni Nickel Solution contains 100 g/l nickel as well as complexing agent and is necessary for make-up only
- SurTec 717 C Complexing Agent contains the complexing agent in order to control the right composition of the alloy layer
- SurTec 700 EN Sodium Zincate Electrolyte, 3x Concentrate is the electrolyte concentrate (containing 30 g/l Zn) for the initial bath make-up
- SurTec 717 CA Corrective Additive

make-up values:

SurTec 700 EN Sodium Zincate Concentrate	300 ml/l	
SurTec 717 I Carrier	4 ml/l	(3-8 ml/l)
SurTec 717 LCD Booster	0.5 ml/l	(0.3-1.5 ml/l)
SurTec 717 Ni Nickel Solution	25 ml/l	(20-30 ml/l)
SurTec 717 C Complexing Agent	60 ml/l	(60-80 ml/l)

analytical values:	zinc	8 g/l	(7-9 g/l)
	nickel	2.5 g/l	(2.0-3.0 g/l)
	sodium hydroxide (NaOH)	140 g/l	(130-150 g/l)
	sodium carbonate (Na_2CO_3)	20 g/l	(max. 70 g/l)

make-up: Steps for make-up:

1. Fill the calculated amount of SurTec 700 EN Sodium Zincate Electrolyte, 3x Concentrate into the clean plating tank.
2. Add the additional NaOH, approximately 40 g/l.
3. Dilute with deionised water to approx. 80 % of the final volume, stir and mix very well. Before adding the additives make sure that the temperature of the electrolyte is not higher than 30°C.
4. Slowly add the calculated amount of SurTec 717 C Complexing Agent at a well-mixed position.
5. Mix the bath for at least 30 minutes (e.g. with filter pumps).
6. Slowly add SurTec 717 Ni Nickel Solution at a well-mixed position.
7. Add the calculated amounts of SurTec 717 I Carrier and SurTec 717 LCD-Booster.
8. Fill up to the final volume with deionised water.
9. Mix the bath and filter for min. 1 hour.
10. Plate until you reach 8 g/l zinc and start the zinc generator to keep the zinc concentration constant.

Now the bath is ready to use.

temperature:	27°C	(25-35°C)
current density:	2.0 A/dm^2	(1.0-4.0 A/dm^2)
current efficiency:	50-60 %	
plating speed:	0.25 µm/min at 2 A/dm^2	
anodes:	pure nickel anodes	
agitation:	horizontally rack movement with approx. 1.5-4 m/min, optionally the rack movement can be additionally supported by flooding with venturi nozzles	
tank material:	polypropylene or steel with PP, PVC or rubber coating	
filtration:	continuously, with 2-3 times the total bath volume per hour pore size: 10-50 µm	
heating/ cooling:	necessary; out of Teflon or stainless steel	
exhaust:	required for worker´s protection	
hints:	Metal impurities can be removed by dummy plating at low current densities (0.1-0.2 A/dm^2).	
	Remove copper parts, which have fallen into the bath immediately.	

recommended process sequence (for iron parts):

1. hot degreasing with SurTec 190 + SurTec 091
2. hydrochloric acid pickling with SurTec 424
3. anodic electrolytic cleaning with SurTec 190
4. neutralisation with SurTec 481
5. **Zn/Ni Electrolyte SurTec 717**
6. activation in hydrochloric acid at pH 1.8-2.5
7. Chromiting SurTec 680 special parameters for Zn/Ni
8. hot air 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 717 I	liquid, colourless-yellowish	1.017 (1.00-1.05)	5.5 (5 - 7)
SurTec 717 II	liquid, yellowish	1.007 (0.96-1.06)	6.2 (5 - 8)
SurTec 717 LCD	liquid, yellowish	1.028 (1.00-1.08)	10.0 (9-11)
SurTec 717 Ni	liquid, violet	1.263 (1.24-1.29)	9.0 (8-11)
SurTec 717 Ni B	liquid, blue	1.257 (1.23-1.28)	7.2 (6-8)
SurTec 717 C	liquid, colourless-yellowish	1.078 (1.02-1.13)	12.2 (10-14)
SurTec 717 CA	liquid, colourless-yellowish	1.001 (0.95-1.05)	> 13
SurTec 700 EN	liquid, colourless	1.332 (1.31-1.35)	> 11

Maintenance and Analysis

Analyse and adjust the content of zinc, nickel and sodium hydroxide regularly. Daily control analyses are recommended to prevent large variations of the metal composition in the bath. Analyse the content of sodium carbonate from time to time. Additives can be dosed according to Ampere-hours.

Adjust the nickel concentration in the bath by addition of SurTec 717 Ni B Nickel Solution. A dosage of 10 ml SurTec 717 Ni B represents 1 g nickel. SurTec 717 Ni B is dosed according to nickel analysis (per AAS or titration).

The zinc concentration in the bath can be adjusted and maintained by an external zinc generator.

Sample Preparation

Take a sample at a homogeneously mixed position. If the sample is turbid, let the turbidity settle down and decant or filter the solution.

Zinc – Analysis by AAS

equipment: atomic absorption spectrometer (AAS):
wave length: 213.9 nm
slit: 0.7 nm

reagents: hydrochloric acid (1:1) p.a.
laboratory standard solutions of 1 to 5 ppm zinc

procedure: Prepare a 1:5000 dilution:

1. Pipette 10 ml bath sample into a 100 ml volumetric flask.
2. Fill up with deionised water and mix well.
3. Pipette 1 ml from this solution into a 500 ml volumetric flask.
4. Acidify with 20 ml half conc. hydrochloric acid.
5. Fill up with deionised water and mix well.
6. Determinate this solution at 213.9 nm against the laboratory standards of 1 to 5 ppm.

correction: Adjust the circulation rate from the zinc generator to reach the correct zinc content.

Zinc – Analysis by Titration

reagents: 0.1 mol/l EDTA solution (Titriplex III)
buffer solution (100 g/l NaOH and 240 ml/l glacial acetic acid, 98 % in deionised water)
dimethyl glyoxime solution (2 % alcoholic solution)
indicator: xylenole orange tetra sodium salt (1 % in KNO_3)

procedure: Repeat determination:

1. Pipette 5 ml bath sample into a 250 ml beaker.
2. Dilute with approx. 25 ml deionised water.
3. Add buffer solution, until the solution gets clear and the colour changes (approx. 20 ml).
4. Add approx. 20 ml dimethyl glyoxime solution.
5. Heat up to 60°C while stirring.
6. After cooling down to room temperature filtrate the solution and wash the filter cake with some DI-water.
7. Add a spatula tip of indicator to the filtrate (inclusive the water from the washed filter cake).
8. Titrate the filtrate with the 0.1 M EDTA from purple to yellow-orange.

calculation: consumption in ml = ml (**A**)
ml (**A**) · 1.3074 = g/l zinc

hint: The colour changes from purple to yellow-grey. It is not possible to describe the colour exactly; it depends on the matrix of the bath sample (e. g. metal impurities).

correction: Adjust the circulation rate from the zinc generator.

Nickel – Analysis by Titration

reagents: 0.1 mol/l EDTA solution (Titriplex III)
buffer solution (100 g/l NaOH and 240 ml/l glacial acetic acid, 98 % in deionised water)
indicator: xylenole orange tetra sodium salt (1 % in KNO_3)

procedure: Repeat determination:

1. Pipette 5 ml bath sample into a 250 ml beaker.
2. Dilute with approx. 100 ml deionised water.
3. Add approx. 20 ml buffer solution, until the solution gets clear.
4. Heat up to 80°C while stirring.
5. Add a spatula tip of indicator.
6. Titrate at 80°C with 0.1 M EDTA solution from purple to yellow-orange.

calculation: consumption in ml = ml (**B**)
[ml (**B**) - ml (**A**)] · 1.1742 = g/l nickel

correction: rise by 1 g/l of nickel = addition of 10 ml/l SurTec 717 Ni B

Nickel – Analysis by AAS

equipment: atomic absorption spectrometer (AAS):
wave length: 232.0 nm
slit: 0.2 nm

reagent: hydrochloric acid (1:1) p. a.
barium chloride solution (15 % $BaCl_2$ in deionised water)
laboratory standard solution of 5-10 ppm nickel

procedure:
1. Pipette 5 ml bath sample into a 100 ml beaker.
2. Cautiously add 10 ml hydrochloric acid (1:1).
   Attention: gas evolution (CO_2)!
3. Fill 20 ml barium chloride solution into a second 100 ml beaker.
4. Warm up both beakers to approx. 70°C.
5. Add the barium chloride solution to the bath sample:
   a precipitation is formed.
6. Let the solution cool down.
7. Fill the solution together with the precipitation quantitatively into a 50 ml volumetric flask.
8. Fill up to the final volume with deionised water, mix well and let the precipitate settle down. This is the pre-dilution of 1:10.
9. From the clear solution from top of the flask, pipette 5 ml into a 100 ml volumetric flask.
10. Add 5 ml hydrochloric acid (1:1).
11. Fill up with deionised water and mix well. This is the final dilution of 1:200 (in summary).
12. Determinate this solution at 232.0 nm against the laboratory standards of 5 to 10 ppm.

correction: rise by 1 g/l nickel = addition of 10 ml/l SurTec 717 Ni B

Sodium Hydroxide – Analysis by Titration

reagents: 1 N sulfuric acid
barium chloride solution (15 % $BaCl_2$ p.a. in deionised water)
indicator: thymolphthalein

procedure:
1. Pipette 5 ml bath sample into a 250 ml Erlenmeyer flask.
2. Add 15 ml of the barium chloride solution.
3. Dilute with 50 ml of deionised water.
4. Add 3 drops of indicator.
5. Titrate with 1 N sulfuric acid from blue to colourless.

calculation: consumption in ml · 7.98 = g/l sodium hydroxide

hint: For the dosage of NaOH, the quality (concentration) of the raw material has to be considered.

Sodium Carbonate – Analysis by Titration

reagents:	barium nitrate solution (5 %) 1 N hydrochloric acid 1 N sodium hydroxide solution indicator: methyl orange solution (0.04 %)
procedure:	1. Pipette 10 ml bath sample into a 250 ml Erlenmeyer flask. 2. Dilute with 50 ml deionised water. 3. Boil the dilution. 4. Add 75 ml barium nitrate solution. 5. After settle down of the precipitate, filtrate with a fine-grained filter paper and wash with hot deionised water. 6. Put the filter into a new 250 ml Erlenmeyer flask. 7. Add 100 ml deionised water. 8. Add 20 ml 1 N hydrochloric acid. 9. Boil the solution shortly. 10. After cooling down, add 3 drops of indicator. 11. Titrate excessive hydrochloric acid with 1 N sodium hydroxide from red to orange-yellow.
calculation:	(20 - consumption in ml) · 5.3 = g/l sodium carbonate
correction:	Carbonate can be removed by chilling equipment at 3-5°C.

Hull Cell Test

Perform all tests in a standard 250 ml Hull cell. Before plating, prepare well the Hull cell panel (pickling and anodic cleaning), it has to be free of zinc and without oil. Plate the freshly cleaned panel in the Hull cell at 1 A for 15 min. Rinse the panel with tap water and dry it with hot or compressed air.

An ideal panel is bright and has equal nickel content over the whole current density area, measurable by X-ray. Because of the high current applied (1 A, 15 min), it is recommended to use fresh electrolyte samples for each variation in the Hull cell test.

Because of the high viscosity we recommend for the test of SurTec 717 C to make a predilution 1:1 with deionised water to ease the pipette handling.

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 717 I	0.5 - 0.7 l
SurTec 717 II	as required
SurTec 717 LCD	0.3 - 0.7 l
SurTec 717 Ni B	6.0-10.0 l
SurTec 717 C	2.0 - 3.0 l
SurTec 717 CA	as required

In order to prevent delays in the production process, per 1,000 l bath the following amounts should be kept in stock:

SurTec 717 I	25 kg
SurTec 717 II	25 kg
SurTec 717 LCD	25 kg
SurTec 717 Ni B	50 kg
SurTec 717 C	50 kg
SurTec 717 CA	25 kg

Product Safety and Ecology

The safety instructions and the instructions for environmental protection have to be followed in order to avoid hazards for people and environment. The Material Safety Data Sheets (according to European legislation) contain explicit details for this.

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

product	*hazard designation*	*water hazard class*
SurTec 717 I	-	WHC 2
SurTec 717 II	Xi - Irritant	WHC 1
SurTec 717 LCD	Xi - Irritant	WHC 2
SurTec 717 Ni	T - Toxic N - Dangerous for the environment	WHC 2
SurTec 717 Ni B	T - Toxic N - Dangerous for the environment	WHC 2
SurTec 717 C	Xi - Irritant	WHC 2
SurTec 717 CA	C - Corrosive	WHC 2
SurTec 700 EN	C - Corrosive N - Dangerous for the environment	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

31 August 2011/DK, AB