SurTec® 715
Alkaline Cyanide-Free Zinc/Nickel Process

Properties

- deposits nickel contents of 11-15 % Ni in the layer
- excellent covering power
- gives very equal zinc/nickel layers over a wide current density range
- excellent heat-resistant corrosion protection with yellow passivation SurTec 679, silver-free black chromate SurTec 699 and particularly with Chromiting SurTec 680
- IMDS-number: 736126

Application

SurTec 715 is applied in rack or barrel application. The process includes the following products:

- SurTec 715 B Base Complex contains the base complexing agent and complexes nickel to reach a defined co-deposition
- SurTec 715 N Nickel Solution contains 67 g/l nickel and is used to keep the electrolyte‘s nickel concentration constant
- SurTec 715 I Carrier is responsible for an equally fine-grained deposition
- SurTec 715 II Brightener brings the desired brightness to the layer
- SurTec 715 LCD Booster works together with the brightener and is responsible for the deep brightness and for the general appearance of the layer
- SurTec 700 EN Sodium Zincate Concentrate contains zinc and sodium hydroxide for the bath make-up (as an alternative to the make-up out of the salts)

make-up values:	*rack*		*barrel*	
sodium hydroxide	130 g/l		130 g/l	
zinc oxide (pure, e.g. Harzsiegel)	12.5 g/l		18.75 g/l	
For an easier bath make-up, SurTec 700 EN Sodium Zincate Concentrate (triple concentrate) can be used instead.				
SurTec 715 B Base Complex	79 ml/l	(65 - 95 ml/l)	65 ml/l	(55 - 80 ml/l)
SurTec 715 N Nickel Solution	22 ml/l	(20 - 24 ml/l)	22 ml/l	(20 - 24 ml/l)
SurTec 715 I Carrier	75 ml/l	(50-100 ml/l)	100 ml/l	(80-120 ml/l)
SurTec 715 II Brightener	5 ml/l	(2.5 - 10 ml/l)	5 ml/l	(2 - 8 ml/l)
SurTec 715 LCD Booster	1 ml/l	(0.75-1.25 ml/l)	1.5 ml/l	(0.5 - 3 ml/l)

analytical values:	*rack*		*barrel*	
zinc (Zn)	10 g/l	(8 - 12 g/l)	15 g/l	(14 - 16 g/l)
sodium hydroxide (NaOH)	120 g/l	(100-140 g/l)	130 g/l	(110-150 g/l)
nickel (Ni)	1.5 g/l	(1.4-1.6 g/l)	1.5 g/l	(1.4-1.6 g/l)
sodium carbonate (Na_2CO_3)	30 g/l	(max. 70 g/l)	30 g/l	(max. 70 g/l)

make-up:	Steps for make-up: 1. Fill in SurTec 700 EN Sodium Zincate Concentrate **or** dissolve sodium hydroxide and zinc oxide in 20 % deionised (DI-)water portion by portion, stirring vigorously (**caution**: **solution becomes hot!**). The solution should be clear and virtually colourless. 2. Add DI-water up to 60 % of the final bath volume. 3. Let the solution cool down. 4. **In a separate tank** premix the additives SurTec 715 B Base Complex, SurTec 715 I Carrier and SurTec 715 N Nickel Solution and stir for 4-5 minutes. 5. Add the premixed solution to the zincate electrolyte, which should be cooled down to 22-27 °C. 6. Finally add the additives SurTec 715 LCD Booster and SurTec 715 II Brightener and mix well.
temperature:	24 °C (22 -27 °C) The selected temperature must be kept as exactly as possible, optimal ± 1 °C.
cathodic current density:	0.5-2 A/dm^2 *barrel* 0.5-5 A/dm^2 *rack*
voltage:	approx. 18 V *barrel* approx. 9 V *rack*
current efficiency:	40-50 %
deposition rate:	0.3 μm/min at 2 A/dm^2
heating/cooling:	Teflon or stainless steel, thermostatic control is required
ratio anode/cathode:	2:1
zinc generator:	separately, with catalytically coated dissolution baskets (SurTec Hydrogen Catalyst); the dimensioning will be calculated individually http://calculation.SurTec.com/Zincgenerator.html
anodes:	pure nickel anodes (DIN 1702)
tank material:	steel with PP or PVC coating
agitation:	rack agitation with 3-5 m/min resp. barrel rotation at 2-4 rpm; air agitation is not possible!
filtration:	continuously: 2-3 bath volumes per hour
pore size:	5-10 μm (out of PP)
exhaust:	recommended
hints:	Metal impurities can only be removed by dummy plating at low current densities (0.1-0.2 A/dm^2). Remove copper parts immediately.

recommended process sequence (for iron parts):

1. **soak cleaning**: clean the parts perfectly with well rinseable cleaners, because the alkaline cyanide-free electrolyte has no cleaning effect at all
   recommendation: **SurTec 188** Alkaline Cleaner
2. **pickling**: HCl 1:1; also in this step, well rinseable inhibitors and acid cleaners are absolutely required
   recommendation: **SurTec 425** Acid Cleaner
3. **electrolytic cleaning**: anodic, only with soft complexing agents
   recommendation: **SurTec 177** Electrolytical Cleaner
4. **activation**: after using an electrolytic cleaner which consists silicates (as SurTec 177), a fluoride activation is necessary
   recommendation: **SurTec 481** Activation Salt
5. **rinsing**: between each step of the pretreatment, good rinsing is required in order to guarantee that neither silicate nor inhibitors nor detergents (tensides) are dragged into the electrolyte; recycled water must be of adequate good quality (in case of doubt, please send a sample for assessment)
6. **pre-dip**: anodic pre-dip in 60-75 g/l sodium hydroxide solution is recommended; then go without rinsing into the plating bath
7. **plating**: **SurTec 715** Alkaline Cyanide-Free Zinc/Nickel Process
8. **rinse**: double cascade
9. **neutralisation**: in 0.3 %vol hydrochloric acid (approx. pH 3)
10. **rinse**: intermediate rinsing recommended before passivation
11. **passivation**: **SurTec 679** Yellow Chromate, **SurTec 699** Black Chromate or **SurTec 680** Chromiting
12. **rinse**: double cascade
13. **sealing**: if necessary, post dip or sealer (imperative after SurTec 699 Black Chromate, see product information sheet)
14. **hot air drying**: 60-80 °C

Technical Specification

(at 20 °C)	Appearance	Density (g/ml)	pH-value (conc.)
SurTec 715 B	liquid, colourless	1.008 (0.95-1.02)	12.0 (11-14)
SurTec 715 N	liquid, dark blue	1.174 (1.14-1.20)	7.2 (6 - 8)
SurTec 715 I	liquid, colourless-yellowish	1.031 (1.01-1.05)	12.5 (10-14)
SurTec 715 II	liquid, light purple	1.012 (1.00-1.03)	11 (10-12)
SurTec 715 LCD	liquid, colourless-yellowish	1.030 (1.01-1.05)	8.5 (7.5-9.5)
SurTec 700 EN	liquid, colourless, clear	1.332 (1.31-1.35)	> 11.0

Maintenance and Analysis

Analyse the concentration of zinc, nickel and sodium hydroxide regularly, sodium carbonate from time to time.

Daily control analysis of the nickel content is necessary because possible excess of nickel cannot be masked but only worked out.

Keep the zinc content constant by an external zinc generator; dose the zinc concentrate, that is formed in the generator, according to the analysis.

Correct deposited nickel and drag-out losses (see: “Consumption”) by adding **SurTec 715 N Nickel Solution**. A dosage of 15 ml/l SurTec 715 N represents 1 g/l nickel. Dose SurTec 715 N according to AAS analysis.

Rising concentration of **SurTec 715 B Base Complex** reduces the build-in of nickel and increases the current efficiency.

Rising concentration of **SurTec 715 I Carrier** reduces the current efficiency and increases the nickel content inside the layer.

Dose **SurTec 715 II Brightener** according to the Hull cell tests. An overdosage reduces the current efficiency and leads to brittle layers with less corrosion resistance.

Dose the additives according to the data above (see „consumption“).

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 down and decant or filter the solution.

Zinc (Zn) – Analysis by Titration

reagents:
0.1 mol/l Na-EDTA solution (Titriplex III)
buffer solution (100 g/l NaOH and 240 ml/l glacial acetic acid)
alcoholic dimethyl glyoxime solution (2 %)
indicator: xylenole orange (1 % in KNO_3)

procedure:
Repeat determination:

1. Pipette 5 ml bath sample into a 250 ml beaker.
2. Dilute with approx. 25 ml DI-water.
3. Add buffer solution, until the solution gets clear and the colour changes (approx. 20 ml, see further on).
4. Add approx. 20 ml dimethyl glyoxime solution.
5. Heat up to 60 °C while stirring, then cool down to room temperature.
6. Filtrate the solution and wash the filter cake with DI-water.
7. Add to the filtrate xylenole orange as indicator.
8. Titrate with the Na-EDTA solution from red to yellowish.

calculation:
consumption of Na-EDTA in ml = ml (**A**)
ml (**A**) · 1.3074 = g/l Zn

hint:
The colour change is from violet to yellow-grey. The colour is not possible to describe exactly, it depends on the matrix of the bath sample.

Zinc (Zn) – Analysis by AAS

equipment:
atomic absorption spectrometer (AAS)
wave length: 213.9 nm; slit: 0.7 nm
100 ml and 500 ml measuring flask

reagent:
hydrochloric acid (1:1) p. a.

procedure:
Prepare a dilution of 1: 5000

1. Pipette 10 ml bath sample into a 100 ml measuring flask.
2. Fill up with DI-water and mix well.
3. From this solution pipette 1 ml into a 500 ml measuring flask.
4. Add 20 ml hydrochloric acid (1:1).
5. Fill up with DI-water and mix well.
6. Determinate this solution at 213.9 nm against the laboratory standards of 1 to 5 ppm.

Nickel (Ni) – Analysis by Titration

reagents: 0.1 mol/l Na-EDTA solution (Titriplex III)
buffer solution (100 g/l NaOH and 240 ml/l glacial acetic acid)
indicator: xylenol orange (1 % in KNO_3)

procedure: Repeat determination:

1. Pipette 5 ml bath sample in to a 250 ml beaker.
2. Dilute with approx. 100 ml DI-water.
3. Add buffer solution, until the solution gets clear (approx. 20 ml).
4. Heat up to 80 °C while stirring.
5. Add directly some xylenole orange as indicator and titrate with the 0.1 mol/l Na-EDTA solution from red to yellowish.

calculation: ml consumption of Na-EDTA = ml (**B**)
[ml (**B**) - ml (**A**)] · 1.1742 = g/l Ni

correction: rise by 1 g/l Ni = addition of 15 ml/l SurTec 715 N

Nickel (Ni) – Analysis by Photometry

instruments: spectrophotometer with 465 nm filter
10 mm cuvette
100 ml and 1000 ml volumetric flask

reagents: sodium hydroxide solution (50 %)
ammonium persulfate $(NH_4)_2S_2O_8$
sodium tartrate
butanedione dioxime (dimethylglyoxime)

procedure: Preparation of the nickel standard solution:

1. Weigh 4.0499 g $NiCl_2 \cdot 6\ H_2O$ into a 1000 ml volumetric flask.
2. Add deionised water to the scale and mix well (1 g/l Ni).
3. Pipette 10 ml of this solution into a 100 ml volumetric flask.
4. Add deionised water to the scale and mix well (100 mg/l Ni). (The standard solution can be used for 6 month.)

Preparation of the process solution:

1. Pipette 15 ml sodium hydroxide solution into a 1000 ml volumetric flask.
2. Fill up with deionised water to approx. 500 ml.
3. Weigh out 0.5 g butanedione dioxime, 20 g sodium tartrate and 5 g ammonium persulfate and add it to the solution.
4. Fill up to the scale and mix till everything is dissolved.

Sample measurement:

1. Reference: Pipette 2 ml of nickel standard solution into 100 ml volumetric flask and fill up to the scale with deionised water.
2. Sample: Pipette 10 ml bath sample into a 100 ml volumetric flask and fill up to the scale with deionised water.
   Pipette 2 ml of this dilution into a 100 ml volumetric flask and fill up to the scale with the process solution.
3. Use the process solution as blanc and measure the absorbance of the reference and sample at 465 nm in a 10 mm cuvette after a reaction time of exactly 15 min.

calculation: Absorbance sample / Absorbance reference = g/l Ni in the bath

hint: The tolerance of this method is about 0.1 g/l Ni.

Nickel (Ni) – 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 %)
nickel laboratory standards

procedure:
1. Pipette 5 ml bath sample into a 100 ml beaker.
2. Add 10 ml hydrochloric acid (1:1) cautiously.
   Attention: gas evolution (CO_2)!
3. Fill 20 ml barium chloride solution into a second beaker.
4. Warm up both beakers to approx. 70 °C.
5. Add barium chloride solution to the bath sample (precipitation will be formed).
6. Let the solution cool down.
7. Fill the solution together with the precipitation quantitatively into a 50 ml measuring 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 measuring 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 Ni = addition of 15 ml/l SurTec 715 N

Sodium Carbonate (Na_2CO_3) – 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. Add 50 ml deionised water.
3. Boil the solution.
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 250 ml Erlenmeyer flask.
7. Add 100 ml deionised water.
8. Acidify with 20 ml 1 N hydrochloric acid.
9. Boil the solution shortly.
10. After cooling down, add 3 drops of indicator.
11. Titrate excess hydrochloric acid with 1 N sodium hydroxide from red to orange-yellow.

calculation: (20 - consumption in ml) · 5.30 = g/l Na_2CO_3

Sodium Hydroxide (NaOH) – Analysis by Titration

reagents:	1 N sulfuric acid indicator: Tropaeolin O (0.04 % in ethanol 50 %)
procedure:	1. Pipette 5 ml bath sample into a 250 ml Erlenmeyer flask. 2. Dilute with 100 ml deionised water. 3. Add 3 drops of indicator solution. 4. Titrate with 1 N sulfuric acid from red to yellow.
calculation:	consumption in ml · 7.98 = g/l NaOH

Hull Cell Test

Do 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 2 A for 15 min. Rinse the panel with tap water, activate it in 0.3 %vol hydrochloric acid (15 s) and rinse again (if desired, passivate it and rinse again) and dry it with hot or compressed air.

An ideal panel is bright over the whole current density area and has an equal nickel content, measurable with X-ray.

Because of the high current applied, it is recommended to use fresh electrolyte samples for each variation in the Hull cell test.

Consumption

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 715 B	0.6 - 0.9 l
SurTec 715 N	7.5 -10.5 l
SurTec 715 I	0.3 - 0.9 l
SurTec 715 II	1.0 - 2.5 l
SurTec 715 LCD	0.8 - 1.1 l

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 715 B	C - Corrosive	WHC 2
SurTec 715 N	T - Toxic	WHC 2
	N - Dangerous for the environment	
SurTec 715 I	-	WHC 1
SurTec 715 II	T - Toxic	WHC 2
SurTec 715 LCD	-	WHC 3
SurTec 700 EN	C - Corrosive	WHC 1
	N - Dangerous for the environment	

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 May 2010/DK, MO