COVENTYA

PERFORMA 560

An Ammonium-free, Acid Zinc/Nickel (12-15% Ni) Process

Beyond the Surface

Requirements of an acid zinc/nickel process

- Technical requirements
  - High plating speed (current efficiency up to 90 %)
  - High thicknesses of deposits
  - Uniform nickel content in the deposits (12 – 15 %)
  - Excellent throwing and covering power
  - Excellent corrosion protection
  - Direct plating on cast iron
  - Easy to passivate
- Decorative requirements
  - High gloss
  - Bright deposits

Important prerequisites

- Installations optimized for acid zinc/nickel processes
  - Separate electric circuits for zinc and nickel anodes
  - Separate rectifiers
- Professional support by cooperation between supplier and plater
- Well equipped analytical laboratory
- X-ray and AA to monitor the process

PERFORMA 560

Applications

- Rack
  - Cast iron (e.g. fittings, swivels …)
  - Spheroidal cast iron (e.g. brake calipers)
  - Sinter metals
- Barrel
  - Screws according to approval by the OEM
  - Cast iron (e.g. fittings, swivels …)
  - Sinter metals
  - Drywall screw

It is important to evaluate the geometry of the parts to obtain a sufficient deposit in all current density ranges.

PERFORMA 560 – Bath parameters

Parameter	Rack				Barrel				Unit
	Range			Optimum	Range			Optimum	
Zinc	25	-	31	28	25	-	31	28	[g/L]
Nickel	24	-	26	25	24	-	26	25	[g/L]
Boric acid	17	-	23	20	17	-	23	20	[g/L]
Chloride	165	-	185	180	165	-	185	180	[g/L]
Sodium acetate (anhydrous)	33	-	37	35	33	-	37	35	[g/L]
PERFORMA 560 BASE	45	-	55	50	45	-	55	50	[mL/L]
PERFORMA 560 ADDITIVE H	20	-	24	22	22	-	24	22	[mL/L]
PERFORMA 560 BRI	1.6	-	2.4	2.0	1.6	-	2.4	2.0	[mL/L]

Parameter	Rack				Barrel				Unit
	Range			Optimum	Range			Optimum	
Zinc	3.35	-	4.15	3.75	3.35	-	4.15	3.75	[opg]
Nickel	3.25	-	3.5	3.35	3.25	-	3.5	3.35	[opg]
Boric acid	2.3	-	3.0	2.7	2.3	-	3.0	2.7	[opg]
Chloride	22	-	25	24	22	-	25	24	[opg]
Sodium acetate (anhydrous)	4.5	-	5.0	4.75	4.5	-	5.0	4.75	[opg]
PERFORMA 560 BASE	4.5	-	5.5	5.0	4.5	-	5.5	5.0	[% v/v]
PERFORMA 560 ADDITIVE H	2.0	-	2.4	2.2	2.2	-	2.4	2.2	[% v/v]
PERFORMA 560 BRI	0.16	-	0.24	0.2	0.16	-	0.24	0.20	[% v/v]

PERFORMA 560 - Bath parameters

pH	5.3		5.6	5.5	5.3		5.6	5.5	
Temperature	33	-	37	35	33	-	37	35	[°C]
Cathodic current density	1.0	-	3.0	2.0	0.5	-	1.2	1.0	[A/dm²]
Anodic current density	0.5	-	2.0		0.5	-	1.0		[A/dm²]
Rack movement	4	-	8	6.0	-	-	-	-	[m/min]
Barrel rotation	-	-	-	-	3	-	5	3.5	[U/min]
Deposition rate	2 A/dm²			~ 0.5	1 A/dm²			~ 0.2	[µm/min]

pH	5.3		5.6	5.5	5.3		5.6	5.5	
Temperature	90	-	100	95	90	-	100	95	[°F]
Cathodic current density	10	-	30	20	5	-	12	10	[A/ft²]
Anodic current density	5.0	-	20		5.0	-	10		[A/ft²]
Rack movement	4	-	8	60	-	-	-	-	[m/min]
Barrel rotation	-	-	-	-	3	-	5	3.5	[U/min]
Deposition rate	20 A/ft²			~ 0.5	10 A/ft²			~ 0.2	[µm/min]

PERFORMA 560 - Bath parameters

Product	* Consumption in liter / 10,000 Ah	1 gallon/AH
PERFORMA 560 BASE	1.8 - 2.8	13,500-21,000
PERFORMA 560 ADDITIVE H	0.8 - 1.3	29,000-47,500
PERFORMA 560 BRI	0.8 - 1.6	23,500-47,500

* Consumption of additives also depends on drag-out.

Function of the single electrolyte components

- Zinc
  - Too high a Zn concentration lowers the nickel content in the deposit. At a zinc concentration < 25 g/L (3.35 opg) burning and excessive Ni alloy can occur in the high current density areas

- Nickel
  - The composition of the alloyed layer and subsequent corrosion resistance depends mainly on the nickel concentration of the electrolyte. Too low a nickel concentration lowers the nickel content. Below 11 % the corrosion resistance is decreased. Too high a nickel concentration will lead to a higher nickel content. When the Ni content is > 16 % the layer will become brittle and the corrosion protection will decrease.

Function of the single electrolyte components

- Potassium Chloride
  - Serves as conductive salt for the electrolyte. Too low a chloride content leads to burning in the high current density areas and lowers the nickel co-deposition. Too high a chloride content increases the nickel co-deposition and reduces the cloud point. Also, too high a chloride level will increase the dissolution of zinc anodes.
- Boric acid
  - Buffers the pH of the solution.
- Sodium acetate
  - Buffers the pH of the solution.

PERFORMA 560

Function of the organic additives

- PERFORMA 560 BASE
  - Works as basic brightener over the entire current density range
  - Eliminates burning in the high current density areas
  - Make-up concentration: 45 - 55 mL/L (4.5-5.5 %)

PERFORMA 560

Function of the organic additives

- PERFORMA 560 ADDITIVE H
  - Increases the cloud point of the electrolyte
  - Make-up concentration : 20 – 24 mL/L (2.0-2.4 %)

- PERFORMA 560 BRI
  - Works as brightener over the entire current density range. Too high a concentration (> 3.2 mL/L, 0.32%) leads to brittle Zn/Ni deposits.
  - Make-up concentration : 1.6 – 2.4 mL/L (0.16-0.24 %)

PERFORMA 560

Equipment

- Tanks - coated steel or plastic.
- Ventilation – necessary to maintain the MAK-value.
- Temperature - Heating / Cooling required via Glass, Ceramic or PTFE equipment

Note: During work stoppages, it is necessary to maintain in the electrolyte temperature at a minimum of 28 ° C. Filter pumps must also be kept running to avoid crystallization of salts.

PERFORMA 560

Equipment

- Filtration and agitation
  - Continous filtration is mandatory to avoid roughness on the parts. A turnover of one to three times the bath volume per hour is necessary. The recommended pore size is 10 - 30 µm.
- Agitation
  - We recommend a homogeneous, soft air agitation (oil- and dust free) for best results. A vertical cathode movement additionally improves the deposit. The use of Venturi-nozzles is possible and has to be adapted to the part geometry very carefully regarding flow, nozzle direction etc.
- Rectifiers
  - Two separate current systems (rectifiers + connections) are necessary. 15 - 20 % of the current should be directed to the Ni - anodes and 80 - 85 % to the Zn - anodes.
  - The residual ripple of the rectifiers must be below 5%.

PERFORMA 560

Equipment

- Anodes / Anode bags
  - Pure zinc anodes (99,99 %) and electrolyte nickel anodes have to be used. The surface ratio of Zn/Ni must be 7:1 to 5:1. Titanium baskets should not be used because they can rapidly be covered with an isolating salt layer. The voltage can then rise to over 10V which leads to the dissolution of the Titanium baskets.
    The material of the anode holder should be Titanium. When Titanium hooks are used the voltage should not exceed 10V to avoid dissolution of the hooks.
  - The anode to cathode distance should be at least 25 - 30 cm
  - The anode bus (copper) should be protected from the Zn/Ni electrolyte with a plastic cover or plated with ~ 50-70 µm sulfamate nickel (recommended).

Equipment

- Anodes / Anode bags
  - Polypropylene (PP) bags should be used to cover the anodes. Before use, the anode bags must be leached in dilute hydrochloric acid and then carefully rinsed. A regular cleaning of the bags is important.
  - During longer work stoppages (~ 1 - 2 days) the zinc anodes should be taken out of the electrolyte to avoid a rise in the zinc concentration. The construction of the plant should allow for hovering of the anodes. The electrolyte can also be pumped into a temperature controlled holding tank.

PERFORMA 560

Pre-treatment

- Usual pre-treatment sequence:
  - PRELIQ or PRESOL Soak cleaner
  - PICKLANE Pickling
  - PRELIQ or PRESOL Electrolytic cleaner (anodic)
  - Activation (Hydrochloric acid 31 %; ~ 50 mL/L, 5%)
  - Rinse (mandatory to avoid iron impurities in the Zn/Ni electrolyte)
  - PERFORMA 560 Zn/Ni current directly after immersion

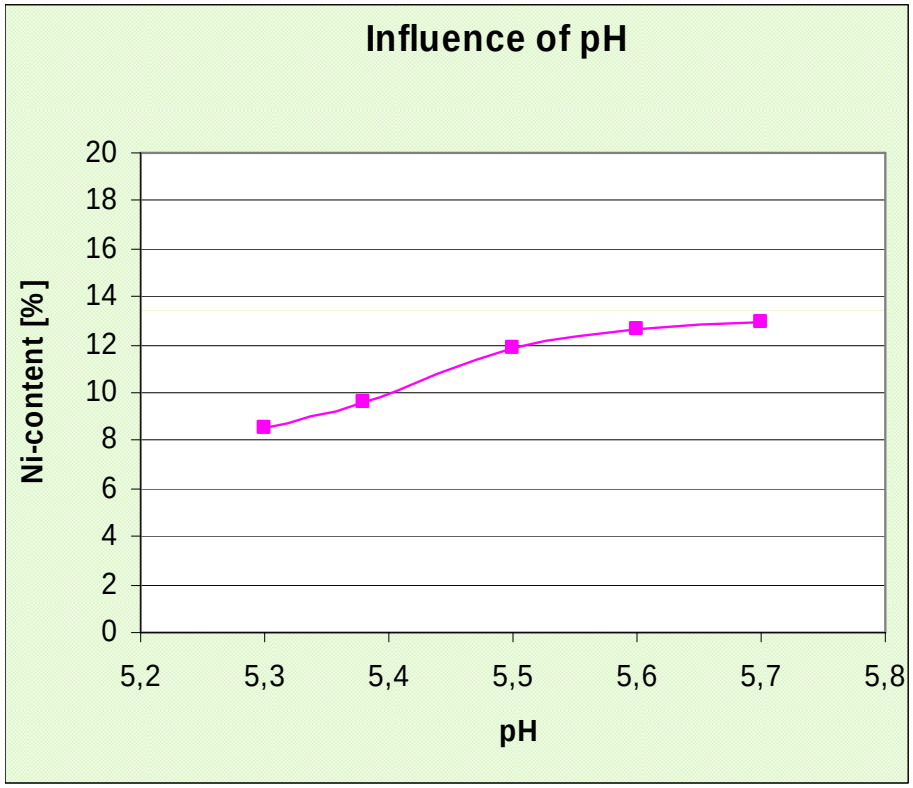
PERFORMA 560

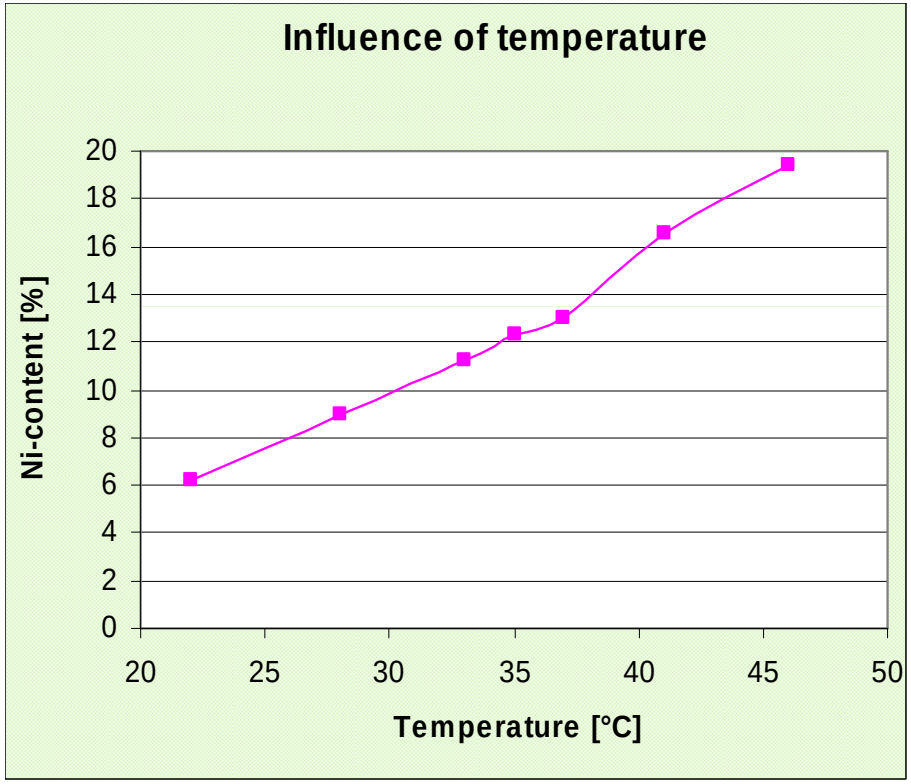
Post-treatment

- After the Zn/Ni electrolyte, parts have to be rinsed quickly and very carefully. Extended times in the rinse tanks should be avoided to eliminate the potential for the deposit to become passive.

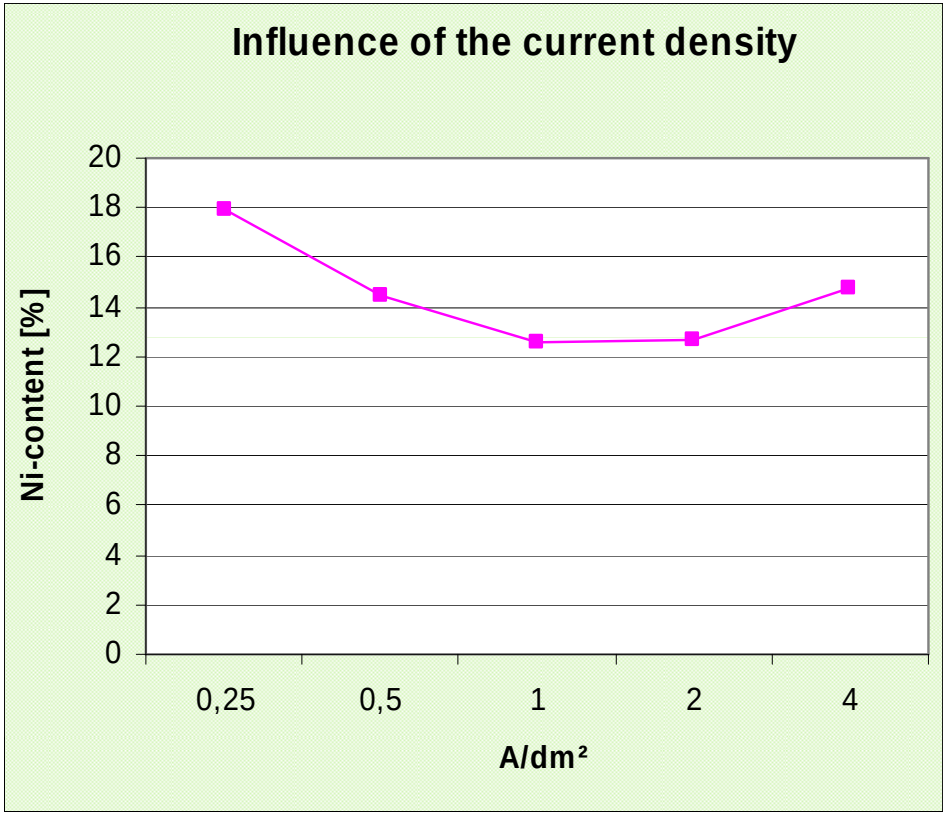
- We do not recommend acid activation prior to passivation. In exceptional cases, parts can be activated in a dilute hydrochloric acid (pH: 3.5 - 5) solution.

Influence of bath parameters on the nickel content





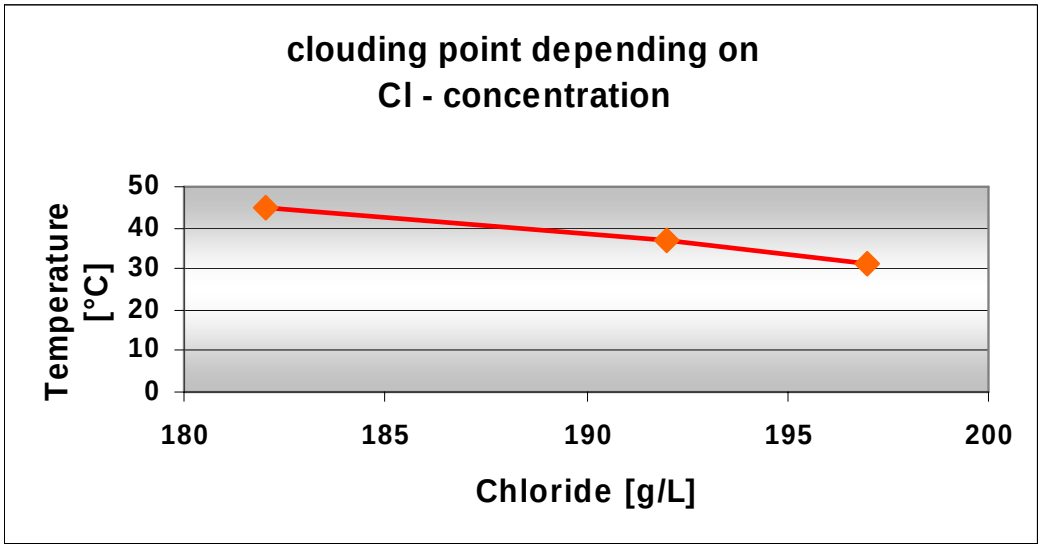
Influence of bath parameters on the nickel content

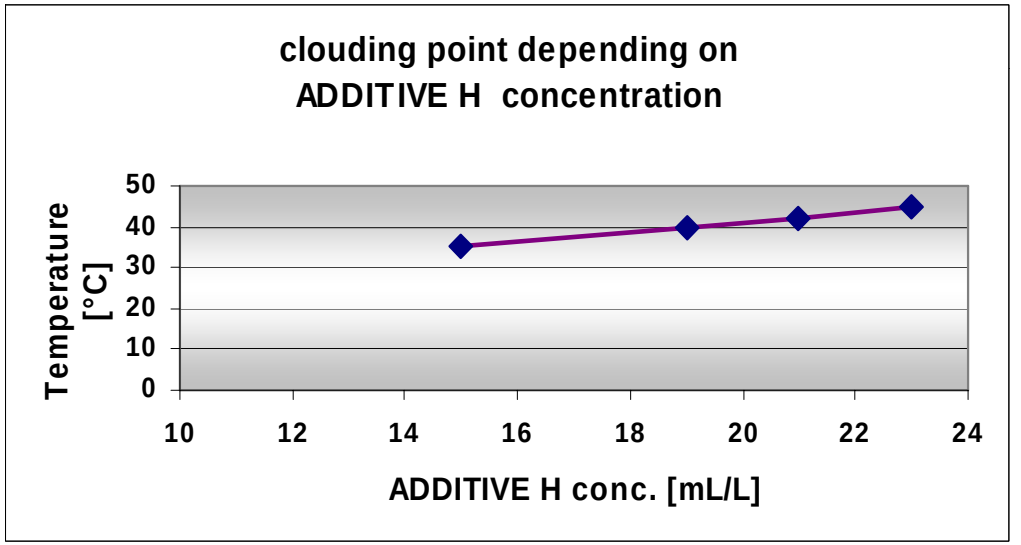


PERFORMA 560

Cloud point

- The cloud point is only controlled by the chloride- and PERFORMA 560 ADDITIVE H – concentration.





PERFORMA 560

Comparison of metal distribution: alkaline Zn/Ni and acid Zn/Ni

Properties of PERFORMA 560

- Fast deposition rate
- Consistent alloy deposition across all current densities (12 - 16% Nickel)
- Excellent throwing power
- Excellent corrosion resistance
- Can be applied directly to cast iron
- Easy to passivate/chromate
- Deposits are bright
- Very Low tendency for by-product formation
- Easily and predictably replenished with 3 additives

Advantages of PERFORMA 560

Benefits to applicator

- Very stable and productive process
- Consistent high quality production
- Will not chip or flake in barrel installations (at normal thicknesses)
- Easy and economical to operate (only three additives)
- No additional replenishment of PERFORMA 560 BASE and PERFORMA ADDITIVE H is needed after prolonged work stoppages
- Deposit brightness can be controlled from semi-bright to very bright by PERFORMA 560 BRI
- Excellent technical support provided by COVENTYA technicians