riag Oberflächentechnik AG · Postfach 169 · CH-9545 Wängi TG

02.11.2020

riag Ni 140

Sulphur free semi-bright nickel process

The **riag Ni 140** semi-bright nickel process gives ductile deposits, can be used in both rack and barrel applications and has an exceptional throwing power.

Properties

- sulphur free deposits (car, bicycle, motorcycle and all parts) when high corrosion resistance is required
- ideal for four step nickel deposits for aluminium plating due to CASS
- ductile deposits
- very active deposits
- depends on the quantity of replenishing solution (**riag Ni 140 Brightener**) brilliant deposits.

Make up

	Rack		Barrel	
	Range	Optimum	Range	Optimum
Nickelsulfat ($NiSO_4$ x 6 H_2O)	250 – 300 g/L	290 g/L	200 – 250 g/L	220 g/L
Nickelchlorid ($NiCl_2$ x 6 H_2O)	25 – 40 g/L	40 g/L	25 – 40 g/L	40 g/L
Borsäure (H_3BO_3)	40 – 50 g/L	45 g/L	40 – 50 g/L	42 g/L
riag Ni 140 Make up	3.0 – 5,0 mL/L	4 mL/L	3.0 – 5.0 mL/L	4 mL/L
riag Ni 140 Brightener	1.0 – 3.0 mL/L	2 mL/L	1.0 – 3.0 mL/L	2 mL/L
riag Ni 138 Tenside M *	* 1 – 3 mL/L	* 2 mL/L	* 1 – 3 mL/L	* 2 mL/L
riag Ni 139 Tenside L *	* 1 – 3 mL/L	* 2 mL/L		
pH-value	3.8 – 4.5	3.8	3.8 – 4.5	3.8

* depending on customer-specific process requirements

Operating values

	Rack		Barrel	
Nickel (Ni^{2+})	60 – 85 g/L	75 g/L	50 – 75 g/L	60 g/L
Chloride (Cl^-)	10 – 15 g/L	13 g/L	10 – 15 g/L	13 g/L
Boric acid (H_3BO_3)	40 – 50 g/L	45 g/L	40 – 50 g/L	42 g/L

Make up

A separate tank is filled with deionised water to 2/3 of the final volume.
The water is then heated to at least 60 °C after which the chemicals are added and the tank is filled to final volume with deionised water. To remove contaminants 0.5 mL/L hydrogen peroxide is added and the solution is stirred for at least one hour. This is followed by addition of 3 g/L **riag Carb SF** activated carbon and mixing for another 30 minutes. After settling, preferably overnight, the electrolyte needs to be transferred to the working tank by filtration. Finally, the correct undiluted volumes of **riag Ni 140 Make up**, **riag Ni 140 Brightener** and **riag Ni 138 Tenside M / riag Ni 139 Tenside L** are added whilst stirring.

Operating Parameters

Temperature:	55 °C (50 – 60 °C)
pH-value:	3.8 (3.8 – 4.5)
Cathodic current density:	Barrel: 0.5 – 2.0 A/dm^2 Rack: 0.5 – 7.0 A/dm^2
Anodic current density:	< 3.0 A/dm^2
Current efficiency:	< 100 %
Deposition rate:	Barrel: at 1 A/dm^2 ca. 0.2 µm/min Rack: at 5 A/dm^2 ca. 1.0 µm/min
Anodes :	Minimum purity 99.7 % Ni. We recommend polypropylene anode bags
Agitation:	Essential: Barrel rotation, filter pump
Tanks:	Plastic or lined steel
Filtration:	It is important to use continuous filtration and we recommend including activated carbon filtration as well. The filtration rate should be two to three times electrolyte volume per hour.
Heating:	Immersion heaters, but thermostatic control is essential
Cooling:	not required
Fume extraction:	Recommended
Maintenance:	Nickel sulphate, nickel chloride and boric acid should be analysed and corrected regularly. To achieve uniform bright coatings the addition of **riag Ni 140 Make up** and **riag Ni 140 Brightener** is important. Dosing via an Ah meter and dosing pump in smaller but regular quantities increases the precipitation quality and reduces consumption of **riag Ni 140 Make up** and **riag Ni 140 Brightener.** Metallic contamination can be removed by frequent selective plating-out at 0.1 – 0.3 A/dm^2. The filter pump should be on with the filter outlet directed at the panels. This will ensure thorough electrolyte circulation and essential agitation at the same time.

pH-value adjustment: To lower the pH chem. pure Sulphuric acid (10 %) is added. To raise the pH only Nickel carbonate must be used. Ammonia or ammonia compounds must not be added.

Additive consumption: The additives are consumed during electrolytic reactions as well a drag-out losses. Consumption can therefore vary depending on the process.

riag Ni 140 Make up	0.5 – 1.5 L/10 kAh
riag Ni 140 Brightener	1.5 – 2.0 L/10 kAh
riag Ni Tenside M / L	0.1 – 0.3 L/10 kAh

Function of electrolyte components

riag Ni 140 Brightener

For uniform bright coatings it is iessential to add **riag Ni 140 Brightener** as indicated in the operating instructions. Dosages of small but regular amounts increase the quality of the coating and reduce the consumption of **riag Ni 140 Brightener**.

riag Ni Tenside M / L

The consumption of **riag Ni 138 Tenside M / riag Ni 139 Tenside L** may vary. It reduces the surface tension and prevents pitting.
A minimum content of **riag Ni Tenside M / L** in barrel nickel application is necessary to avoid, for example, the formation of perforation stains on flat parts, which repeatedly stick on the barrel wall.

riag Ni 143 Purifier

Zinc-die casting processing in rack or barrel mode often leads to zinc and copper electrolyte contamination. This can be treated by additions of 0.03 – 0.1 mL/L **riag Ni 143 Purifier**. The volume **riag Ni 143 Purifier** to be added depends on contamination levels but overdosing results in loss of deposit brightness as well as levelling and must be avoided.

Activated Carbon

Continuous filtration over activated carbon is recommended. This can be done via a by-pass whereby the carbon will remove organic contaminants such as oils and breakdown products.
For this we recommend our **riag Carb SF** dust-free product which has an active surface area of 1500 m^2 /g. The additional brightener consumption should not exceed 5 %.
A significant contamination of the electrolyte can be removed by filtration in the bypass (filter pump with a filled sack of **riag Carb GR**). **riag Carb GR** is ideally suited for this purpose, as such treatment may be performed during the plating process. **riag** can provide such filter system.

riag Ni 147 Oxidant

Iron contamination (pitting) can be removed effectively by additions of **riag Ni 147 Oxidant**. The maximum concentration of 0.5 g/L should not be exceeded. The salt is first dissolved in hot water and the iron is removed via the filter.

Structure of the deposit

Structure of a semi-bright nickel deposit in dependence of pH value and current density.

Ideal value:	pH	3.8 – 4.4
	A/dm^2	0.5 – 7.0

For semi bright, sulphur free nickel deposit (specially for multilayered nickel deposit. It is very important to have a columnar structure)

Environmental considerations and product safety

All concentrates, rinse waters and waste solution must be treated and discharged in accordance with local effluent control regulations. Information can be gleaned from the material safety data sheets. Chemicals shall not be stored below 10 °C.

Liability

This instruction manual was compiled with reference to the state of the art and all current standards, and is based on the long-term knowledge and experience of riag. However, riag cannot monitor compliance with this instruction manual and the methods described herein at the customer/end-user's premises. Work carried out with riag products must be adapted accordingly to meet local conditions. In particular, riag cannot accept liability for damage, loss or cost incurred due to a failure to adhere to this instruction manual, improper application of the methods, unauthorised technical modifications, insufficient maintenance or the absence of maintenance in respect of the requisite technical hardware or equipment, or in the event of use by unqualified personnel. riag is not liable for damage or loss caused by riag or its employees except where intention or gross negligence can be proved.
riag furthermore reserves the right to make changes in relation to products, methods and the instruction manual without prior notice.

Our goods and services are subject to the General Terms and Conditions for Delivery of the Association of Surface Technology Suppliers (VLO), which can be viewed at www.riag.ch (link “terms and conditions" , document “General Terms and Conditions for Delivery", version 3/2018), which we gladly send you on request.

This transaction is governed by material Swiss law (Law of Obligations), excluding private international law (conflict of laws) and intergovernmental treaties, specifically the CISG.

riag Oberflächentechnik AG
Murgstrasse 19a
CH-9545 Wängi
T +41 (0)52 369 70 70
F +41 (0)52 369 70 79
riag.ch
info@riag.ch

Analysis (Analytical Methods)

Sample preparation:
The sample must be taken from a well-mixed point and allowed to cool down to 25°C.

Boric acid

Reagents:	Sodium hydroxide solution 0.1 mol/L Bromcresol purple (1 % in Ethanol) Mannitol	
Procedure:	10 mL	electrolyte are transferred via pipette into a 100 mL measuring flask and filled up to the mark with deionised water followed by mixing well.
	10 mL 250 mL 100 mL	of this mixture is given into a beaker via pipette followed by deionised water addition.
	2 – 3 g	Mannitol is added followed by addition of 10 drops Bromcresol purple. Titration with
	0.1 mol/L	Sodium hydroxide from yellow to green, to dark green and finally to blue-violet.
Calculation:	Boric acid (g/L) = consumption of mL NaOH x 6.18	

Nickel chloride hexahydrate

Reagents:	Silver nitrate solution 0.1 mol/L Potassium dichromate solution 5 %	
Procedure:	5 mL 250 mL 50 mL	electrolyte are transferred into a glass beaker and diluted with deionised water.
	10 drops	of Potassium dichromate solution are added. Titration with 0.1 mol/L Silver nitrate solution from white yellow to a light brown end point.
Calculation:	Nickel chloride hexahydrate (g/L) = consumption of mL $AgNO_3$ x 2.380 Chloride (g/L) = consumption of mL $AgNO_3$ x 0.709	

Nickel

Reagents:	Buffer solution pH 10 Na_2EDTA 0.1 mol/L Murexide (Sodium chloride 1: 100)	
Procedure:	10 mL 100 mL 10 mL 15 mL 100 mL 1 spatula tip	electrolyte are transferred via pipette into a measuring flask and filled- up to the mark with deionised water and mixed well of this mixture is given into a 250 mL glass beaker by pipette followed by Buffer solution addition deionised water and of Murexide are added The sample colour should then be deep yellow Titrate immediately with Na_2EDTA 0.1 mol/L to a blue-end- point
Calculation:	Nickel (g/L) = consumption of mL Na_2EDTA 0.1 mol/L x 5.869 Nickel sulphate hexahydrate (g/L) = [A – (B x 0.247)] x 4.48 A = Nickel concentration in g/L B = Nickel chloride conc. in g/L	

riag Ni 138 Tenside M

Reagents:	Glycerine Butyl phosphate solution: Mix	5 mL Tri-n-Butyl phosphate 500 mL Methanol 500 mL water DI
Procedure:	25 mL 3 drops 0.5 mL	electrolyte are transferred via pipette into a 300 mL Erlenmeyer flask, add glycerine, shake well, to form a foam cover. Add in steps of butyl phosphate solution, shake well after each addition, until the foam cover disappears within 10 seconds
Calculation:	consumption in mL = mL/L **riag Ni 138 Tenside M**	