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PCI SEMINICK PROCESS

PCI SEMI NICK Semi Bright Nickel process produces very active, ductile highly leveled, sulphur free Nickel deposits. This process is suitable as an undercoat for Multi layer Nickel Plating processes which gives exceptional potential values between semi bright and bright Nickel deposit to achieve high corrosion resistance thereby meeting the latest requirements of all Automotive Majors.

PCI SEMI NICK coatings generally consist of a relatively thick coating of semi-bright nickel (60-75% of the total nickel thickness) followed by a thinner bright nickel coating. These are commonly referred to as dual-layer or duplex nickel. Semi-bright nickel differs from bright nickel in that it has no co-deposited sulphur. This sulphur-free nickel has a lower electrochemical reactivity than the bright nickel. **PCI SEMI NICK** process can be used on a variety of substrates such as steel, brass, zinc-die castings, copper or plastics as an undercoat in the duplex system and is compatible with all the PCI Bright Nickel Plating Processes.

PCI SEMI NICK process gives consistent potential values at wide range of operating concentrations, temperatures and current densities. Hence the passivity and peel off between the two layers never takes place This process does not require frequent purification treatment, hence saving on the production loss.

Importance of PCI SEMI NIK Semi Bright Nickel Plating

To understand how **PCI SEMI NIK** provides increased corrosion resistance, it is necessary to briefly examine the mechanism of corrosion.

Under the effects of moisture and atmospheric contaminants, corrosion initiates in cracks or pores in the chromium topcoat. As the chromium is electrochemically more noble than the nickel, corrosive attack takes place in the bright nickel with the formation of pits. As corrosion continues, the pitting becomes deeper and eventually reaches the substrate, resulting in rusting or other base metal corrosion. At the same time the thin chromium layer may become partly dislodged through undercutting. Because bright nickel is relatively electrochemically active, the rate of attack can be quite rapid under corrosive conditions.

With **PCI SEMI NIK** process the bottom layer of semi-bright nickel is electrochemically noble compared with the bright nickel. Therefore corrosion will take place preferentially in the bright nickel layer. The result is that, when the attack reaches the interface, corrosion will tend to spread laterally in the top layer rather than penetrate into the semi-bright coating. Microscopic examination shows typically flat bottomed pits in the bright nickel. This effectively retards the pitting attack because, before the pit can penetrate further, a considerable portion of the bright nickel layer must be removed.

WORKING CONDITIONS

Nickel Sulphate	: 250 - 300 gms/lt
Nickel Chloride	: 50- 60 gms/lt
Boric Acid	: 45 - 50 gms/lt
SEMINIK 101	: 2 -5 ml/lt
SEMINIK 103	: 0.5 - 1.5 ml/lt
SEMINIK 104 (OPTIONAL)	: 0.5 - 1.5 ml/l 1 ml/l
SEMINIK ANTI PITTEA A (OPTIONAL)	: 1 - 4 ml/l (as required)
Temperature	: 50 -60° C
pH	: 4.5 - 4.8
Agitation	: Air or Mechanical
Cathodic Current Density	: 1- 4 A/dm ²
Current Efficiency:	: 98 %
Deposition Rate:	: 0.6 µm/min at 3 A/dm ²
Anode/Cathode Ratio	: 2:1
Packing	: 30 LTS HDPE Carbuoy.

MAINTENANCE :

SEMINIK 101 produces the desired deposit characteristics by functioning co-operatively with the SEMINIK 103 or 104 levellers. SEMINIK 101 is normally only added at the time of make-up.

SEMINIK 103 contributes levelling and overall brightness. The consumption of this leveller is within the range of 80 – 100 cc/KAH. The additions should be frequent and small.

SEMINIK 104 is used in installations where higher step test results are desired. SEMINIK 104 retains all of the appearance and performance characteristics of 103 and produces high (120 - 170 mV) STEP test results. This is an optional additive For optimum levelling and ductility, the colour of the deposit should be pearly-grey.

METHOD OF USE & CONTROL

SOLUTION PREPARATION :

The storage tank should be used in preparing a new Nickel Plating Solution. The storage tank, if newly lined with rubber or synthetic materials, should be first leached with a solution containing 2 % by volume Hydrochloric Acid and 0.2 % by volume SEMINIK ANTI PITTEA A. The solution should be heated to 50 - 65° C and maintained at that temperature for at least 8 hours with occasional stirring. The tank should then be emptied and rinsed thoroughly before use.

To prepare the solution :

1. Heat water in storage tank to 60 - 70° C and maintain (about 2/3 full).
2. Dissolve the required amount of nickel sulphate.
3. Add nickel chloride.
4. After material has all dissolved add enough nickel carbonate to raise pH to a value of at least 5.2. Stir thoroughly.
5. Add 2gm/l activated carbon powder (1200 I.V.) and stir for 30 - 60 minutes.

6. Allow solution to settle for 3 - 4 hours or preferably overnight.
7. Filter into clean plating tank and heat to 60^o C.
8. Add the necessary quantity of boric acid and agitate the solution until dissolved
9. Dilute to final volume and heat to operating temperature.
10. Adjust the pH to 3.5 with well diluted sulphuric acid.
11. At this point is advisable to "dummy" the solution by electrolysing at about 5.4 ASD for 12 hours. Use of agitation and filtration during this period is beneficial
12. Readjust the pH if necessary.
13. Add required amount of addition agents, such as brightner and carrier.
14. Circulate for 20 minutes and start plating

CONSTITUENTS

Nickel Sulphate :

The nickel content should be determined at least once a week and adjusted at regular intervals. Normally a concentration of 225 to 350 gm/l of nickel sulphate is specified because this provides a sufficiently high metal concentration for all purposes. If the plating job is particularly difficult (deep recesses, sharp corners, irregular shapes, etc.) or if the current concentration required is above 4.5 -6.5 amperes per litre, the nickel salts concentration should be carried at the higher level.

Nickel Chloride :

The nickel chloride content should be determined and corrected at the same frequency suggested for nickel sulphate and should be maintained within the limits specified. Low nickel chloride content will result in poor anode corrosion and low efficiency leading to depletion of the nickel content of the solution and/or breakdown of the addition agents.

Boric Acid :

The boric acid content of the solution should be determined and adjusted at least once a week. The control and maintenance of the boric acid content of the plating solution between the specified limits is essential for several reasons:. While boric acid is not generally recognised as an efficient buffer in the pH range used for the nickel solution, it is an experimental fact that there is noticeably less gassing at the cathode and increased operating efficiency when the boric acid content is kept within the specified limits. Excessive gassing at the cathode causes streaking, as pocketing and is an indication of low operating efficiency. Low boric acid content also contributes to "orange peel" type of pitting.

TEMPERATURE

The temperature of the Seminik solution should be maintained at between 50 - 75^oC. The use of automatic temperature control is recommended to assist in maintaining constant operating conditions. Equipment requirements should be considered, e.g. tank linings and air agitation lines, when operating at higher temperatures.

pH

The pH of the SEMINIK solution should be determined regularly and maintained within the range 4.5 - 4.8. Dilute sulphuric acid (one part sulphuric acid to ten parts water) should be used to lower the pH. when necessary to raise the pH, nickel carbonate may be used by application to the filter.

EQUIPMENT

Plating Tanks :

Rubber or PVC Lined steel, composition, ceramic or glass tanks which have been approved for use with PCI Nickel Processes should be used. Lead-lined, stainless steel, wood or pitch-lined plating tanks are not approved.

Pumps and Fittings

Construction materials of pumps, fittings, circulation lines and all associated equipment such as filters and heat exchangers should be used..

Heating

Glass coated steel, , electrical heating units and other suitable types as well as external heat exchangers may be used for heating the plating solution. Titanium heating coils can satisfactorily be used in many instances.

Filtration

Circulation of the plating solution through a filter at a rate sufficient to turn the tank volume over at least once every two hours is recommended for mechanically agitated solutions. Air agitated solutions are preferably turned over at least once per hour. The filter may be of any type which will keep the solution free from suspended dirt or foreign particles. Return lines should be of non-metallic materials, or if they are metallic they should be suitably lined so as to prevent any bi-polarity in the electrical circuit. They should be so positioned in the tank that direct impingement of the solution stream on the work is avoided. Circulating lines must be so arranged that a recirculating slurry feed tank can be used. No solution should be returned directly to the plating tank after an addition to the filter without first ascertaining by recirculation that the solution is perfectly clear. The slurry tank used for this purpose must be placed above the level of the pump.

Agitation

Air

For air agitation, a blower of sufficient capacity to provide filtered oil-free air should be used. "Compressed" air should definitely not be used. The blower should be large enough to provide air at a pressure of one pound per square inch for each 18 inches of solution depth and a volume capacity of one cubic foot per minute for each linear foot of immersed perforated pipe. If the blower is mounted below the level of the plating solution, an anti-siphon device should be installed at the uppermost portion of the header pipes.. Metallic pipe, in any form, is not approved.

Mechanical

Agitation is strongly recommended. Slow oscillatory agitation of 3 - 8 ft per minute is sufficient in still tank operation. Ordinary chain speeds in automatic operations are usually satisfactory

Anode Area and Anode Current Density

Active Anode area, i.e. that area subject to electrolytic corrosion, must be maintained at the highest practical level. In "still" tanks sufficient active anode area must be provided to maintain the anode current density below 18 ASF. In highly agitated tanks, e.g. air agitated, the anode current density should not exceed 30 ASF. However, the type of nickel anode material and anode bag material as well as agitation can raise or lower these arbitrary anode current density limits. If this limiting current density is continually exceeded, there will be a tendency for the anodes to polarise leading to loss of current, possible loss of ductility and poor corrosion protection. Anode area should be checked frequently and anodes added or positioned so as to present the maximum area until completely corroded..

OPERATING PRECAUTIONS

Anode Bags

Nickel anodes and baskets must be fitted with bags to prevent nickel fines or nickel sulphide residues entering the plating solution. Polypropylene is widely used for anode bags because of its durability. However, other fabrics including cotton and other synthetics are used successfully. Care should be taken to avoid tearing or damage to the bags. This is a common problem when using bar anodes or primary nickel strip, where sharp tips from partially corroded anodes may tear the bags. Bags should be examined frequently for tears, cuts or bruises, and replaced where necessary, since fine particles from the anode will cause roughness if allowed to enter the solution. The use of two bags or double walled bags may be advisable in installations where frequent cutting or tearing occurs.

TITRATION & ANALYSIS :

Sample Preparation

Take the sample at a homogeneously mixed position and let it cool down to room temperature. If dull, allow to settle and decant or filter.

Nickel

Pipette 1 ml of the plating solution into 500 ml conical flask, dilute it with small quantity of distilled water. Add about 5ml of ammonium hydroxide solution and a few grains of Murexide indicator. Shake the flask well and titrate against 0.1 M EDTA to purple colour end point. Note the reading, let it be 'a' ml of EDTA.

Calculation : 'a' ml of EDTA X 5.869 = gm /ltr. Nickel metal in bath.

Nickel Chloride

Pipette 5 ml of the solution into a 500 ml Conical flask and dilute with distilled water. Add few drops of potassium chromate indicator and titrate against 0.1 N silver nitrate until the white precipitate of silver chloride takes on a very faint reddish brown tint. It requires practice to detect the exact end point easily. Note the reading

Calculation : ml of 0.1 N AgNO₃ used X 2.378 = gm/ltr NiCl₂6H₂O in the bath.

Nickel Sulphate

From total nickel metal and Nickel Chloride concentration Nickel Sulphate can be calculated as follows:

[gm/ltr. of Nickel Metal –(gm/ltr. of Nickel Chloride x 0.247)] x 4.79 = gm/ltr of NiSO₄7H₂O

Boric acid

Pipette out 1 ml of the plating solution into a conical flask. Add 2-3 gms of Mannitol powder and shake well to make a slurry. Titrate with N/10 Sodium Hydroxide after adding 2-3 drops of Bromocresol purple as indicator, The end point is yellow to blue.

Calculation : ml of N/10 NaOH used X 6.184 = gm/ltr. Boric Acid in the bath



PCI SEMINICK

CONVERSION OF EXISTING SOLUTIONS

Most semi-bright nickel solutions can be satisfactorily converted to the PCI SEMINICK process. The levels of Nickel ions should be replenished and adjusted by Nickel Sulphate, Nickel Chloride and Boric Acid. The conversion should be carried out by removing the organic contaminants by purification treatment with Hydrogen Peroxide and Activated Carbon. Then the level of Brightner and Carriers be adjusted after consulting the PCI team.

NOTES :

Further Technical Assistance & MSDS can be sought from PCI, any time .

DISCLAIMER : The data in this leaflet corresponds to our latest knowledge. However, it is not possible to derive any liability there from. Each processor will be himself liable for observation of all regulations, for suitability in a particular application or in matters of legislation or patent law.

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