TECHNICAL DATA SHEET

SPECTEK 790 BRIGHT NICKEL PROCESS

Spectek 790 is an ultra high performance process with its ability to provide extraordinary white bright low current density areas on wide variety of different base metals. The process offers outstanding levelled deposits even with thin coating of nickel. Deposits are ductile, low stressed and easily accept subsequently chrome deposit.

Spectek 790 process give brightness and particularly good leveling, within a broad current range, and are suitable for vat and barrel plating.

SALIENT FEATURES:

1. Brilliant white deposits with strong leveling even in medium and low current density areas.
2. Simple bath operations and gives good tolerance to metallic contaminations.
3. Enhances leveling and quick brightening ability without adversely affecting physical properties of the deposit.

SOLUTION COMPOSITION:

	VAT	
	OPTIMUM	**RANGE**
Bright Nickel Salt	350 g/l	300-400g/l
Nickel Additive 1022	10 ml/l	8-12ml/l
Spectek 790	0.6ml/l	0.5-1.0ml/l

OPERATING CONDITIONS:

	VAT		BARREL	
	Optimum	**Range**	**Optimum**	**Range**
Temperature	55°	55-65°c	50°c	45-55°c
pH	4.2	3.8-4.5	4.6	3.8-4.2
Cathode current density in Amp/sq.ft	40	25-60	10	5-20
Anode current density in Amp/sq.ft	20	10-30	10	5-20
Voltage	5.5	4.0-12.0	12.0	10-16
Agitation	Low pressure air/cathode rod agitation			
Filtration	Continuous for Vat, two to four changes per hour.			
Anodes	Cast carbon, electrolytic nickel, rolled anodes, S nickel rounds in titanium anode baskets.			

FUNCTIONS OF SOLUTION CONSTITUENTS:

NICKEL SULPHATE:

Nickel Sulphate is the main source of nickel ions to the operating solution.A low Nickel Sulphate yields low concentration of Nickel ion which reduces the overall cathode efficiency A high nickel sulphate level allows higher operating current densities.

NICKEL CHLORIDE:

Nickel chloride improves the bath conductivity and anode dissolution. Lower concentration can reduce the conductivity of the bath whereas higher concentration of nickel chloride can lead to increased attack on processing equipment and decrease deposit ductility.

BORIC ACID:

Boric acid acts as an overall pH buffer for the solution and prevents burning, pitting giving ductile deposits.

However higher concentration can lead to shelf roughness, if it is present in a concentration above its solubility limit.

TEMPERATURE:

The optimum temperature to be maintained is in the range of 45 to 60°C. Too low an operating temperature can cause high current density burning at normal amperages. Higher values of temperature doesn't help base it gives rise to unnecessary energy loss.

pH CONTROL:

The recommended pH range for rack plating solutions is 4.0-4.6 and for barrel plating solution is 4.0-4.4.A lower pH is suggested for barrel plating to minimize laminated deposits, and to ensure maximum deposit ductility.

Due to difference in efficiencies of cathode and anode, it is generally tendency of the solution that pH is increased during regular operation. The necessary change in pH should be made, with technical grade sulphuric acid to reduce the pH and Nickel carbonate to increase the pH. Use of sodium hydroxide is not recommended.

CURRENT DENSITY:

The Anode current density is calculated by following equation.

Anode current density = total current /total anode surface area

Similarly,

Cathode current density=total current/ total cathode surface area

Too high an operation cathode current density can produce burning while too low a cathode density results ion decreased plating speed. Similarly too high anode current density (i.e. too low anode area) can cause anode polarization and generation of chlorine gas at the anode. While too low and anode current density can lead to increase in Nickel content in the bath during bath operation.

AGITATION:

Low pressure Air agitation is more commonly used. Compressed air is not satisfactory due to likely hood of introducing oil to the nickel solution.

EQUIPMENTS:

PLATING TANK:

A steel tank lined with PVC, PP or rubber can be used, however rubber lined tank must be latched before use.

HEATING ELEMENTS:

Electric immersion heaters of titanium, tantalum, Carbate are recommended

FILTRATION:

Continuous filtrating through a mixture of filter aid and activated carbon is suggested for optimum performance. Approximately 0.2gm of activated carbon should be added for each liter of operating solution per week.

The filter capacity should be selected to turn the solution over at least 3 to 5 turn overs / hour.

PURIFICATION:

Most common metallic impurities found in nickel solutions are copper, zinc chromium, lead, and iron. Copper, Zinc, and lead can be removed by using corrugated dummy cathode at current density of 3 amps per sq.ft. Higher agitation

Low pH and high temperature is recommended.

OXIDATION CARBON TREATMENT:

When the solution is contaminated severely with organic impurities, an oxidation carbon treatment is required and is carried out as follows:

Heat the solution (about 70°C) adds nickel carbonate and raises the pH to 5.2

Add 1-2 grams of potassium permanganate dissolved in water and 2-3 cc per liter of hydrogen peroxide with air agitation and stir well. Add 3 grams per liter activated carbon

and air agitate for 2 hours. Leave it over night and filter it back into the plating tank without disturbing the sludge settled at bottom of the tank.

This treatment consumes Nickel Additive 722/ 1022 and brightener Spectek 790 partially and therefore 2-6cc per liter Nickel Additive 722/ 1022 and 0.1 – 0.2 cc/l of Spectek 790 is suggested.

SOLUTION PREPARATION:

A fresh nickel plating bath is prepared as follows:

- Leach a rubber lined tank and filled with 5 % sulphuric acid (by volume) and 1 cc/lit Antipit 10 at 50-70° C and agitate the bath for some time. Leave it overnight and clean it with soft water next day.
- Fill the plating tank with 2/3rd of warm water and add required amount of Nickel Salt by stirring to dissolve completely.
- Make the level and adjust the pH to 2.5-3.5 with pure sulphuric acid (25% volume)
- Dummy the solution at 3 amps per sq.ft. for minimum of 12 hours. Remove the anodes and plate at low c.d.
- Pump the hot solution to the storage tank and add sufficient nickel carbonate and stir to raise the pH to 5-5.5 and add 2cc/1 (100 o volume)

  Hydrogen peroxide stir vigorously at 50-70^{0}C for 2 hours.
- Add 2 grams per liter activated carbon and air agitable for some time and leave it over night.
- Filter the solution back into the clean plating tank without disturbing the layer of sludge on the bottom of tank.
- After addition of brightener and pH adjustments the bath is ready for plating.

REPLENISHMENT ADDITIONS:

Replenishment additions should be normally based on the ampere hours of plating done. The required amount of addition depends upon degree of leveling and brightness required drag out, base out base metal finish, and operating temperature etc.

Based on our experience, the replenishment addition is expected to be in the following range.

Spectek	790	125-200 cc/Amp –hr.
Nickel Additive	722/1022	150-250 cc/ Amp –hr.

MAINTENANCE:

Where the anode dissolution is proper the nickel salt is generally lose only by drag out and by general wastage. So a daily addition of nickel salt is recommended and the solution is analyzed regularly to maintain as under:

Nickel metal:	60-80 g/l
Chloride as Nickel chloride	35-70 g/l
Boric acid	40-45 g/l

ANALYTICAL PROCEDURE

ESTIMATION OF NICKEL:

Pipette 1 ml of the plating solution into a 500 ml conical flask and dilute it with a small quantity of distilled water. Add about 5 ml of ammonium hydroxide solution

And a few grains of Murex idée indicator. Shake the flask well and titrate against 0.1M.E.D.T.A. To purple color end point. Note the reading let it be "a" ml of E.D.T.A.

CALCULATION:

"a" ml of E.D.T.A. x 5.869=gm/lit Nickel metal in bath.

ESTIMATION OF NICKEL CHLORIDE:

Pipette 5ml of the solution into 500ml conical flask and dilute with distilled water. Add few drops of potassium chromate indicator and titrate against 0.1N 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 Silver nitrate used x 2.378=gms/lit Nickel chloride ($NiCl_2$-$6H_2O$) in the bath.

ESTIMATION OF NICKEL SULPHATE:

From the total Nickel Metal and Nickel Chloride concentration nickel sulphate can be calculated as follows:

[(gm/lit of Nickel metal)-(gm/lit of Nickel chloride x 0.247)] x 4.79 =gms/lit Nickel sulphate ($NiSO_4 7H_2O$)

ESTIMATION OF BORIC ACID:

Pipette 1 ml. of the plating solution into 500ml. conical flask, add one spatula of Mannitol powder, Swirl it to make slurry, add 2-3 drops of Bromocresol purple and titrate it against 0.1N sodium hydroxide to violet colour end point.

CALCULATION:

ml of sodium hydroxide x 6.184=gm/lit of Boric acid.

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