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CHEMICAL
The Zinc Plating Experts

COLTIN-Zn

Tin-Zinc Alloy Plating Process
TECHNICAL DATA
05-30-14

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COLTIN-Zn
PROCESS FOR TIN-ZINC ALLOY PLATING

COLTIN-Zn	provides an excellent finish for all grounding applications.
COLTIN-Zn	has excellent lubricity (torque-tension).
COLTIN-Zn	is a uniform, level and ductile tin-zinc alloy with excellent adhesion properties.
COLTIN-Zn	delivers outstanding salt spray results.
COLTIN-Zn	mitigates galvanic corrosion rate in contact with aluminum and magnesium.

OPERATING PARAMETERS

Component	Range	Optimum
Tin metal (Sn^{2+})	16.0 - 24.0g/l	20 g/L
Zinc metal (Zn^{2+})	10 - 18.0g/l	11 g/L
CTZ A-Salts 100	75.0 - 100 g/l	85 g/L
CTZ B-Salts 200	60 - 150 g/l	100 g/L
CTZ Carrier 300	1.0 - 2.0 % v/v	2% v/v
Temperature	27 - 38°C (80 - 100°F)	29°C (85°F)
pH	6.0 - 6.8 (6.2 - 6.3)	6.3
Cathode current density	0.43 - 0.76 ASD (4.0 - 7.0 ASF)	0.43 ASD (4 ASF)
Anode current density	1.6 2.7 ASD (15.0 - 25 ASF)	2.16 ASD (20 ASF)
Anodes	75 - 80% Tin / 20 - 25% Zinc	75% Tin / 25% Zinc
Anode bags	must not be used	
Filtration	1 - 3 tank turnovers / hour	2 turnovers/hour
Agitation	mechanical (do not use air)	
Barrel rotation	3 - 7 rpm	4 rpm

Notes:

1. Filtration alone may be adequate solution movement. A re-circulation pump in the plating tank is a definite advantage in barrel operation.
2. pH is maintained in the plating bath with commercially available ammonium hydroxide and sulfuric acid.
3. Note that tin & zinc metal specifications are obtained specifically by using analytical control methods designed for this process. Other analysis procedures <u>MUST NOT BE USED!</u>

SOLUTION MAKE-UP

	100 Liters of Bath	100 Gallons of Bath
Zinc Sulfate Monohydrate:	3 Kg	25 Pounds
Stannous Sulfate:	3.6 Kg	30.2 Pounds
CTZ A-Salts 100:	8.5 Kg	71 Pounds
CTZ B-Salts 200:	5.2 Kg	43 Pounds
CTZ Carrier 300:	2 Liters	2 Liters

1. Fill the tank half full with water.
2. Add the CTZ A-Salts 100 and dissolve.
3. Add the Stannous Sulfate and dissolve.
4. Add the Zinc Sulfate and dissolve.
5. Add the CTZ B-Salts 200 and dissolve.
6. Slowly adjust the pH up to 6.3 with Ammonium Hydroxide.
7. Add the CTZ Carrier 300.
8. Dummy plate.

MAINTENANCE ADDITIONS

Tin and Zinc metal:

The tin metal and zinc metal concentrations in the plating bath are very important in maintaining the proper co-deposition of the metals in the final alloyed plating. The concentration range of each metal in the Operating Parameters are required to maintain a consistent and viable process.

Co-deposition of the alloy may also be controlled to an extent with current density. An increase in current density increases the zinc in the deposit. At a current density of 0.43 - 0.76 ASD (4 - 7 ASF) the alloy is easily maintained between 65 - 80% tin and 20 - 35% zinc. At current densities below 0.315 (3ASF) the percent of tin increases rapidly. Lower current densities may be run, however increases in CTZ Carrier 300 may need to be added.

COLTIN-Zn ADDITION AGENTS

CTZ A-Salts 100 is responsible for the complexing of the metals and to provide a uniform deposition of the metals. Levels of this component must be maintained within the operating parameters. At Lower levels the metals in the bath may precipitate. At higher levels an increase of tin will be observed.

CTZ B-Salts 200 is responsible for increasing the conductivity of the bath. Concentration must be maintained within the operating parameters.

CTZ Carrier 300 is responsible for providing a smooth, level deposit. Carrier 300 also serves as a wetting agent expediting the removal of gas bubbles from the surface of the part. Higher levels in the bath may increase the zinc in the deposit. Lower levels are associated with less tin in the deposit.

Replenish the CTZ Carrier 300 at 1 Liter/ 2,100-2,650 amp hours (1 gallon/8,000 - 10,000 amp hours).

pH

The pH of this process is operated between 6.0 - 6.8. The overall pH of the system aids in the control of the proper co-deposition of alloy. In general with decreasing pH an increase of tin in the deposit will occur, likewise with an increase in pH an increase of zinc will occur.

TEMPERATURE

Alloy electroplating is significantly influenced by temperature and the tin-zinc alloy is no exception. The control of temperature is absolutely critical to the success or failure of applying a tin-zinc alloy coating. As temperatures increase the tin content increases, as temperature decreases, the zinc increases. The temperature range requirements of this system are 27 - 38°C (80 - 100°F).

Temperatures below 27°C (80°F) are not desirable due to a decrease in the conductivity of the bath. At temperatures above 38°C (100°F) an increase of plating chemicals may be consumed.

Temperature in this system has virtually no effect on the appearance of the part.

FILTRATION

Continuous filtration at a rate of 1 - 3 tank turnovers per hour is required. 10 micron pads on a horizontal plate filter is recommended.

ANODES

Anodes may be purchased commercially. Configuration of the anode is dependent on the plating line engineering and the required anode area required on the line based on cathode area and production requirements. Anode composition 75% tin 25% zinc may be used, however alternative alloy composition have also been applied successfully. Anode configuration will be specifically engineered for your application.

CONTROL OF CONTAMINATION

Adequate rinsing is essential for the elimination of cross-contamination. Individual stations (ie cleaners, acids, rinses, plating tank, chromate) should be inspected periodically for good overflow. It is important to maintain clean rinses before the process. Minimize the amount of Iron introduced into the plating tank by having at least 3 rinses after the acid activation tank. It can be helpful to hang magnets within the tank to capture iron particles before they dissolve.

CHEMICAL ANALYSIS & CONTROL

The following analysis should be monitored on the plating bath.

Zinc:	Daily
Tin:	Daily
pH:	Constantly (automated)
Hull Cell (Thickness & alloy)	Daily
CTZ A-Salts 100:	Daily
CTZ B-Salts 200	monthly (quantitative) qualitative weekly (Hull Cell Voltage)

HANDLING & STORAGE

Use normal precautions when handling COLTIN-Zn addition agents - wear protective clothing, rubber gloves, and adequate eye protection. As with most chemicals, use in well ventilated areas.

COLTIN-Zn addition agents are stable on standing, with a shelf live in excess of 1 year.

FREEZABILITY: As with most chemical products, it is preferable that freezing be avoided. However if freezing should occur during transportation or storage, directions for handling the products covered in this technical data sheet are as follows:

If COLTIN-Zn addition agents freeze, simply allow the container to completely thaw and bring to room temperature of 70 - 75°F/ 21 - 24°C. Thoroughly mix to bring back to original condition.

Basic Analysis for COLTIN-Zn Baths

Analysis for Zinc Metal

Reagents Used

+ Xylenol Orange Indicator - add 0.1 gms xylenol orange tetrasodium salt to 100 gms sodium chloride and mix well.
+ Acetate Buffer - dissolve 90 gms of anhydrous sodium acetate in 750 mls of distilled water. Add 15 mls of concentrated acetic acid, dilute to 1 liter with DI water. Mix well.
+ 0.0575 M EDTA - dissolve 21.6 gms C.P. disodium EDTA salt in distilled water, dilute to exactly one liter.

Titration Procedure

1. Pipette a 5 ml sample of the bath sample into a 250 ml Erlenmeyer flask.
2. Add approx. 2ml of 2N Hydrochloric acid to the flask.
3. Add 3-4 drops of 30% Hydrogen Peroxide to the flask.
4. Add 1 ml of 5% ammonium biflouride to the flask.
5. Add 50 mls of D.I. water.
6. Add 8-10 mls of 1N Sodium Hydroxide to the flask.
7. Add 10-15 mls of Acetate Buffer to the flask.
8. Add xylenol orange to the flask.
9. Titrate with 0.0575 M EDTA to a yellow endpoint.

CALCULATION: Zinc (g/L) = mls 0.0575M EDTA used X 0.7575

For Additions in Pounds/Gallon:

Zinc (g/L) Target = A
Zinc(g/L) Current = B
Volume of Tank(gallons) = C

$$\frac{[(A-B)\ (C \times 3.785/454]}{(0.36)} = \text{Pounds of Zinc Sulfate monohydrate to add.}$$

For Additions in Kg/Liter:

Zinc (g/L) Target = A
Zinc (g/L) Current = B
Volume of Tank(Liters) = C

$$\frac{((A-B) \times (C / 1000))}{(0.36)} = \text{Kg of Zinc Sulfate monohydrate to add.}$$

Zinc Analysis by Atomic Absorption (AA)

1. If the sample has suspended solids filter the sample.
2. Pipette 0.01 ml of the plating solution into a 100ml volumetric flask.
3. Fill the flask to approximately ½ volume with D.I. water.
4. Add 5 ml concentrated nitric acid to the flask.
5. Dilute the flask to volume with D.I. water and mix.
6. Read the sample on the AA utilizing 1,2, and 4 ppm standards.
7. Record the AA reading.

Analysis for Tin Metal

Titration Procedure

1. Pipette a 10 ml sample of the bath sample into a 250 ml Erlenmeyer flask.
2. Add approx. 50ml of 2N Hydrochloric acid to the flask.
3. Add 2 ml of 1% Starch Indicator solution to the flask.
4. Titrate the solution with 0.1N iodine/iodate solution from colorless to a dark blue endpoint.

Note: Titrate the solution quickly without agitation until the final 5 ml. Allow the titrant to run down the sides of the flask (this limits oxidation).

CALCULATION= Tin (Sn^{+2}) g/L= ((mls iodate/iodide) – 2.5) x (0.59345)

For Additions in Pounds/Gallon:

Tin (g/L) Target = A
Tin (g/L) Current = B
Volume of Tank(gallons) = C

$$\frac{[(A-B)\ (C \times 3.785)/454]}{(0.553)} = \text{Pounds of Stannous Sulfate to add}$$

For additions in Kg/Liter:

Tin (g/L) Target = A
Tin (g/L) Current = B
Volume of Tank(Liters) = C

$$\frac{[(A-B) \times (C / 1000)]}{(0.553)} = \text{Kg Stannous Sulfate to add.}$$

Analysis for CTZ A-Salts 100

Titration Procedure

1. Pipette a 1 ml sample of the bath sample into a 250 ml Erlenmeyer flask.
2. Add 10 ml concentrated sulfuric acid to the flask.
3. Titrate quickly with 1N potassium permanganate to a pink/rose endpoint which lasts for 60 seconds.

CALCULATION: CTZ A-Salts 100 (g/L) = (g/l tin x 0.017) – (mls 1N potassium permanganate) x (15)

For Additions in Pounds/Gallon:

CTZ A-Salts 100(g/L) Target = A
CTZ A-Salts 100 (g/L) Current = B
Volume of Tank (gallons) = C

[(A-B) (C*3.785)/454] = Pounds of CTZ A-Salts 100 to add.

For Additions in Kg/Liter:

CTZ A-Salts 100(g/L) Target = A
CTZ A-Salts 100(g/L) Current = B
Volume of Tank (Liters) = C

[(A-B) (C / 1000)] = Kg of CTZ A-Salts 100 to add.

Analysis for CTZ B-Salts 200

Titration Procedure

1. Pipette a 10 ml sample of the bath sample into a 500 ml Erlenmeyer flask.
2. Add 50 ml of D.I. water to the flask.
3. Add 8-10 ml of 2N hydrochloric acid to the flask.
4. Heat the flask on a hot plate to just below boiling.
5. Over 3-5 minutes add 200 ml of 10% barium chloride solution to the flask.
6. Continue to heat for 10 minutes at below boiling,
7. Pre-dry a glass sintered funnel for 1 hour at 121 degrees centigrade (250F) and get a Tare weight. (Glass sintered funnel= pyrex 36060: 350ml porosity, 4 to 5.5 micron fine)
8. Filter the contents of the 500 ml Erlenmeyer flask through the filter. (Check the filtrate by adding 1 ml of 10% Barium Chloride solution. The solution should remain clear).
9. Wash the contents of the filter with hot D.I. water 4 times with 15-20 ml portions.
10. Dry the flask and the solids collected in an oven at 121 degrees centigrade (250º F) for 1 hour.
11. Weigh the funnel and calculate the weight of the solids by subtracting the tare weight.
12. Calculate as below.

[((Weight of funnel and sample) – (Weight of funnel)) x((grams of barium sulfate collected)X (25.9))]= g/L CTZ B-Salts 200 .

For Additions in Pounds/Gallon:

CTZ B-Salts 200(g/L) Target = A
CTZ B-Salts 200(g/L) Current = B
Volume of Tank (gallons) = C

$$\frac{[(A-B)\ (C*3.785)/454]}{0.72} = \text{Pounds of CTZ B-Salts 200 to add.}$$

For additions in Kg/Liter:

CTZ B-Salts 200(g/L) Target = A
CTZ B-Salts 200(g/L) Current = B
Volume of Tank (Liters) = C

$$\frac{[(A-B)\ (C/1000)]}{0.72} = \text{Kg of CTZ B-Salts 200 to add.}$$

NON-WARRANTY

The data in this bulletin is believed by Columbia Chemical Corp. to be accurate, true, and complete. Since, however final methods of use of this product are in the hands of the customer and beyond our control, we cannot guarantee that the customer will obtain the results described in this bulletin, nor can we assure any responsibility of the use of this product by the customer in any process which may infringe the patents of third parties.