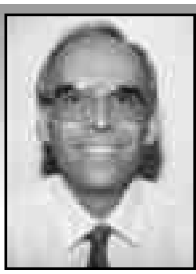

Finishers' Think Tank

Stephen F. Rudy, CEF • Enequist Chemical Co.
100 Varick Avenue • Brooklyn, NY 11237 • 718/497-1200 • E-mail: sfrudy@aol.com

2001: A Plating & Surface Finishing Odyssey The Journey Continues, Part 8

Table 1—Alkaline pH Tin-Zinc

Typical Plating Solution

Component	oz/gal Range	oz/gal Opt.	g/L Range	g/L Opt.
Caustic Potash	0.87-1.17	1.03	6.5-8.8	7.7
Tin	5.09-7.05	6.07	38.2-52.9	45.6
Zinc	0.68-0.94	0.81	5.10-7.06	6.08

Typical Operating Parameters

Temperature	135-165°F	57-74°C
Agitation & Filtering	mechanical (no air)*	continuous light carbon
Cathodic Current Density	10-25 amp/ft^2	1-2.5 amp/dm^2

**Filter return and eductor type movements are good.*

Upon exiting RonZin Parkway, our bus adds to congested traffic at the typically busy intersection of Ferrous Junction & Ferric Boulevard. A report on radio station WZINC advises motorists to stay clear of our current location. Too late for us. We learn an over-capacity crowd at Tin II Stadium has left the ball park, and is a major contributor to congestion of the main roads. Incidentally, the TinZinc Solder Strips, in a rematch, edged the NiZinc Bombers in overtime. Zack Nilko, frustrated Bombers manager, said the litmus test for the Solder Strips is their inability to take the heat, and impending difficulty to maintain their high team payroll. Nick Stannous, Solder Strips manager, replied: "We're proven tough, accept conversions in strategy, and promote sacrificial team effort." The playoffs should fuel this rivalry. The alloy teams provide some outstanding qualities and features. This helps maintain their strong group national standing. In fact, major worldwide manufacturers have specified members of the alloy zinc league as either applicable or compulsory finishes. We discussed these points while reviewing our lengthy trip through the *Zinc Alloy* state.

Quality time resulted in gradual easing of the traffic jam. Finally at the train station, we hop aboard the 50/30 TinZn express, leaving track 9 for our trip to the Tin-Zinc district. Our train was hastily assembled using 12 cars and 14 cars, respectively, from the Zn and Sn lines. This was done to accommodate the post-game crush we experienced while maneuvering to the train station. Pulling away, we built speed after passing *Zinc Iron* manufacturing district—rail marker 118.65. After a few miles, our route traverses through a pristine landscape, consisting of rolling meadows and picturesque forests. At rail marker 118.65, we acknowledge entry into the *Tin-Zinc* state. Nearby was a banner urging the Solder Strips on to the playoffs. Fans sure don't waste time. Who can blame them? Technology is continually changing to meet the challenges of improved wear resistance, corrosion protection, and effluent handling and discharge. Our trip covers a progressively rocky terrain, traversed by clear streams. The ascent culminates in a panoramic landscape of lustrous silvery gray and bluish-white mountains. Catching the right angle of the daytime sun, the snow-capped peaks reflect a bright yellow iridescence. Moving along, the valley and *Tin-Zinc* industrial complex loom below.

Crossing over Lake Stannum, via the Dendrite Memorial Bridge, takes us into the main business district. Our train stops at terminal 2 of the SnZn depot. We assemble, meeting Tina Zincatta, our local tour director. Tina has been assigned by the Technology Center to enlighten us about tin-zinc alloy plating. Our trip begins with a short drive on Stannic Parkway, exiting on to Stannous Boulevard. In a few minutes, we turn on Technology Circle, pulling up to the impressive Technology Center. We are given folders describing the tour agenda, and important, finishing-related information. Entering the main reception hall, Tina points out the recent additions required by the rapid growth and expansion of tin-zinc plating in the last 10 years.

We learn that tin is a silvery white metal, somewhat ductile and malleable. The most common form of tin is found in the cassiterite mineral. Its reduction by heating produces tin metal. On warming, the gray alpha form changes at 58°F (13.2°C), into the white beta form. This reaction is reversible on cooling. Elemental tin is resistant to water (salt, fresh, and distilled). Tina confirms the highlights about zinc and its superior corrosion resistance from our recent *Zincmalia* and *Alloy Zinc* visits. It's the unique alloy combination of tin and zinc that significantly raises the corrosion protection performance bar.

Tin-zinc offers neutral pH and alkaline pH plating solutions, for rack and barrel applications. Sample formulations for each system are shown in Table 1.

The anodes consist of assay: 75% tin and 25% zinc. Insoluble, stainless steel anodes may also be used. For this option, routine maintenance additions of the plating salts are made to replenish and maintain specific concentration ranges.

Table 2 shows sample formulations for neutral pH tin-zinc.

Process tanks for these systems may be lined steel, CPVC, or reinforced polypropylene. Heat sources may be electric or steam. Exhaust ventilation per OSHA regulations and meeting regional air quality specifications is required.

This bath produces a functional deposit that is readily chromated.

Table 2—Neutral pH Tin-Zinc

Typical Barrel Plating Solution

Component	oz/gal Range	oz/gal Opt.	g/L Range	g/L Opt.
Antioxidant	9.1-12.5	10.8	68-94	81
Stabilizer	14-16.7	15.3	105-125	115
Tin	0.73-1.4	1.07	5.5-10.5	8.0
Zinc	0.73-1.4	1.07	5.5-10.5	8.0

Note: The concentration tin in the neutral baths represents the stannous (Sn^{+2}) oxidation state.

Typical Barrel Operating Parameters

Temperature	65-85°F	18-29°C
pH	6-7	6-7
Agitation & Filtering	mechanical (no air)	continuous light carbon
Cathodic Current Density	3-12 amp/ft^2	0.3-1.2 amp/dm^2

The anodes should be assay 75% tin and 25% zinc.

Typical Rack Plating Solution

Component	oz/gal Range	oz/gal Opt.	g/L Range	g/L Opt.
Antioxidant	9.1-12.5	10.8	68-94	81
Stabilizer	14-16.7	15.3	105-125	115
Tin	1.5-2.8	2.15	11-21	16
Zinc	0.58-1.1	0.86	4.4-8.4	6.4

Typical Rack Operating Parameters

Temperature	65-85°F	18-29°C
pH	6-7	6-7
Agitation & Filtering	mechanical (no air)*	continuous light carbon
Cathodic Current Density	12-23 amp/ft^2	1.2-2.3 amp/dm^2

**Filter return and eductor type movements are good.*

The anodes should be assay 75% tin and 25% zinc.

Tin-Zinc Deposit "Thumbs Up"

- Excellent ductility and solderability.
- Corrosion resistance is equivalent to zinc-nickel deposits.
- Complements zinc for very good sacrificial protection of steel.
- No post-plate whiskering.
- Consistent, uniform deposit throughout wide range of current densities.
- Excellent deposit covering power.
- Deposit not susceptible to bimetallic corrosion.

Tin-Zinc Deposit "Thumbs Down"

- Poor abrasion resistance (soft deposit).
- Poor deposit throw.
- Not recommended for elevated temperature exposure of the deposit.
- Thickness of deposit should be within 0.01 mm (4/10 in.).
- Industrial chillers may be required to meet operating temperature range.
- More expensive than other zinc alloys.

Chromating contributes significantly to salt spray protection of the tin-zinc plated deposit.

The data in Table 3 illustrate this effect.

Although clear chromate is an option, the yellow chromate is more commonly applied. Mechanical handling of the chromated deposit, such as bending, does not alter the excellent corrosion resistance to red rust. However, heating the plated and chromated deposit will reduce hours to red rust.

Maintenance & Tune-up

The following procedures help maintain an optimized process bath and deposit.

- Wet analytical titration for tin and zinc; potassium hydroxide for the alkaline pH bath.
- Specific wet chemical or instrumental methods of analysis for antioxidant and stabilizer.

Table 3
Neutral Salt Spray Protection per ASTM B-117

Tin-Zinc & Yellow Chromate

Deposit Type	Hr to White Rust	Hr to Red Rust
*70% tin	100 (average)	at least 2,000

**Remainder of alloy deposit is predominantly zinc.*

- Optionally use atomic absorption spectroscopy for tin and zinc analysis.
- pH should be measured electrometrically, using a calibrated, temperature- compensated pH meter.
- Hull cell plating evaluations for overall deposit characteristics.

Deposit thickness is rapidly and accurately determined by non-destructive X-ray fluorescence method. The same procedure can be used to determine the ratio of tin to zinc in the deposit, or at specific current densities. Other methods, such as thickness by deplating, strip and weight loss, and magnetic determination, can also be used.

Corrosion tests of the deposit can be determined by specific ASTM methods, such as the neutral salt spray.

In the Big Leagues

Our tour included several plating lines. The operations were producing a range of parts. Each line was represented by a team leader, who described the specific operation, maintenance, and control.

Tina updated us on tin-zinc plating applications for the various industries, focusing on some of the parts we saw being plated. The diversity certainly impressed us. It ranged from improved characteristics and service life to offering a more favorable environmental status.

Applications include:

- Direct replacement for cadmium in fasteners.
- Functional automotive parts.
- Glass-to-metal seals.
- Electronics (power transmission & metering devices). Good conductivity.
- Marine and military.

Our tour of the industrial complex ended at the main Technology Center entrance. A souvenir packet of tin-zinc-plated parts and pamphlets were distributed to everyone. We arranged for Tina to receive a fresh bouquet of the nicest flowers native to Zincmalia.

Upon bidding farewell, the bus made its way to Tin Can Alley, a short cut to Stannic Route 4. After a short trip, we arrived at the SnZn depot. Our train was scheduled to depart from track 46.

We had enough time to freshen up and enjoy dinner at the Bright Tin Club. The talk over dinner was how much Zincmalia already has to offer, and we haven't yet visited the *Zinc Cobalt* state. *P&SF*