

# ELECTROLESS NICKEL

## What's New About EN?

**A**fter a 5 year hiatus, the Electroless Nickel Conference sponsored by Products Finishing magazine returned. Clearly this was a signal that there is renewed interest in electroless nickel (EN) technology and advances thereof. Over 100 attended including several international registrants. The conference kicked off with a full day of "Collaborative Approach to EN Basics" in which the suppliers of EN chemistry presented an all encompassing overview of everything EN from equipment, solution formulation, substrate pretreatment to post treatments and waste treatment of spent solutions. The audience was comprised of platers new to EN and OEM's seeking to optimize its application in their designs.

Bill Fields, owner of Palm Commodities and leading supplier of liquid nickel sulfate to the industry, delivered the main conference's keynote address. He pointed out that \$110,000,000 is spent annually on EN chemicals. With nickel prices soaring to \$25 per pound in late 2007, it was no surprise that much of the conference dealt with nickel saving strategies such as low-metal baths which operate at 1/2 the traditional nickel concentration. Anoplate tried an early version of this well over 3 years ago and it quickly

became evident that our job shop variability didn't lend itself to operating in this mode. However, many high volume shops serving the automotive sector have successfully adopted this approach. Other nickel saving strategies emphasized the importance of solution velocity and recovery of otherwise spent solutions using electro dialysis. New pretreatments for magnesium and plastics free from chromic acid were discussed. However, one of the more intriguing discussions of interest to Anoplate surrounded a new non-sulfate based nickel solution which touted the ability to control stress levels such that, for example, aluminum parts could be plated throughout a bath's life.



**Figure 1. Unwanted Nickel Deposit**

Anoplate's Chief Technology Officer, Milt Stevenson, Jr., presented a paper highlighting the firm's year long internal initiative to extend bath stability and prolong its life. Since early 2004 our efforts had centered on converting conventional EN baths which relied on lead for stability and cadmium for brightness to ELV –compliant, lead-free / cad-free technology. That early initiative on Anoplate's part paid off when OEM's began to demand ELV, RoHS, and WEEE compliant nickel free from lead and cad. As one might imagine, you don't just remove two ingredients that an entire industry had

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# Leave The Masking To Us!

**O**ne of the key services that Anoplate has to offer, besides its broad range of finishes, is its masking capability. For close to fifty years this skillful, clever portion of our processes sets us apart from the majority of our competition. Since masking can be a very time consuming part of a given procedure, we are often asked by our customer, "can I mask it and save some time and money?" Most often we are reluctant to allow this to happen. Let's explain why.

There are a multitude of reasons, but let's start with one of the more obvious ones. If you mask your part and the masking is not correct to the print, who is responsible for the rework and subsequent cost, assuming the part can be reworked which is not always the case? In the case of hardcoat anodizing or nickel from copper alloys, for example, the stripping and rework to salvage parts can be very "iffy". A portion of the base material is removed in both these cases resulting in dimensional loss and a noticeably duller appearance when recoated.

Next, what cleaning and pre-treatment will you do to maintain the maximum adhesion of the tape or stop-off paint? If this masking leaks, is it due to our cleaning/processing procedure or possibly your poor preparation? Are the plugs you have placed in the blind holes installed correctly so as to prevent them from "blowing out"? All too often the success or failure of any masking operation can be attributed to the method of pretreatment prior to masking.

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become reliant on and move on. Each EN supplier approached the reformulation from a different perspective: one used bismuth for stability, others pursued various all organic versions. There was no single solution and each had its own idiosyncrasies when it came to operation in a job shop plating environment. Once we had settled in on which RoHS-technology was most suitable for Anoplate, our attention focused on equipment and operating parameters to offer optimum performance. For instance, while legacy baths “loved” air agitation, the new formulations seemed to “loathe” air so we opted for improved solution agitation incorporating eductors. We soon learned that eductors alone wouldn’t suffice without strategically locating where the solution was dispersed when it was returned to the tank. Figures 1 & 2 show before and after results.

In ‘08 while the price of nickel had stabilized and somewhat receded, EN platers are now confronted with shortage and related price increases for another key ingredient, namely sodium hypophosphite, typically referred to as “hypo” by EN platers. Hypo is the reducing agent that enables the nickel to plate out and is the source of the phosphorous in the deposit. The majority of the hypo used by the industry comes from China and besides struggles from a devastating earthquake and reports of curtailed electrical and chemical production in the months leading up to the Olympics, there is pressure worldwide on the raw materials used to produce any “P4” bearing chemical including hypo. Is it more important to produce fertilizer to feed the world’s masses or make hypo to support EN platers? It’s obviously much more complicated than that, but the impact of hypo more than doubling in cost over the last year and shortages in the supply chain are just beginning to be felt. Over the last couple of months price increase letters related to this issue have been received from each of our current 3 EN suppliers. In face of these price surges, Anoplate’s initiatives to extend bath life and optimize stability are about to pay even greater rewards while advancing technology opens new markets and opportunity for Anoplate’s ENhanced nickel family.

## IT’S A SMALL WORLD



**A**noplate continues to maintain its global connectiveness networking with customers, suppliers and fellow finishing firms across the globe. In October ‘07 Frank Leyendecker, General Manager of eight AIMT plating and heat treating facilities across Germany visited our facility. AIMT, which purchased the former AHC group of plating firms, operates over 40 metal treating facilities in more than a dozen European countries. Anoplate management personnel have visited a number of AIMT finishing facilities in Germany over the years.

Last year, Anoplate’s President and Chief Operating Officer, Jim Stevenson, spent 10 days in Taiwan and China as a follow up to a customer request for a fact finding study. Observations were made regarding management style, what new technology and technical skills were being utilized as well as the evaluation of our competitive position with regard to China. A similar visit to Mexico followed this summer.

Also recently, Milt Stevenson, Jr., Chief Technology Officer, attended Hanover Messe in Germany, the world’s largest industrial technology exhibition, followed by a meeting of the International Hard Anodizing Association held in Karlovy Vary, Czech Republic. Milt served as President of this international group from 1999 – 2001 and maintains close ties with its European members.

Milt Stevenson, Sr. CEO attended the tenth world meeting of ISTMA (International Special Tooling and Machining Association), held in Juneau, Finland. This is a tri-annual meeting of the precision machine industry, a major segment of Anoplate’s core business, and this gives us a glimpse of international trends in this all important business sector.

Milt Stevenson, Jr. presented a paper at the 13th Electroless Nickel Conference entitled Controlling Dynamic EN in a Rigid Nadcap Regimen. The paper was co-authored by Christine Koch, Sean Novak, and Dino Aimino from Anoplate’s process control and engineering group. The conference boasted attendees from all over the US and 8 foreign countries.



Figure 2. No Nickel After 1 Week

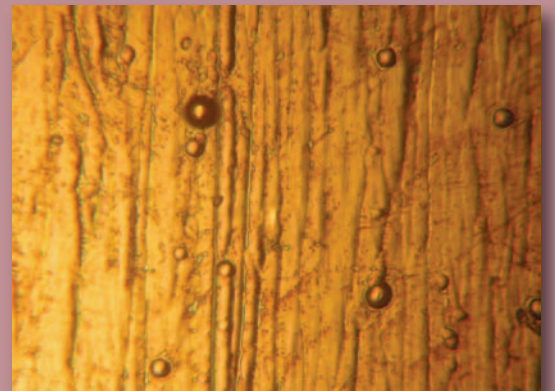


Figure 3. Nodules in EN

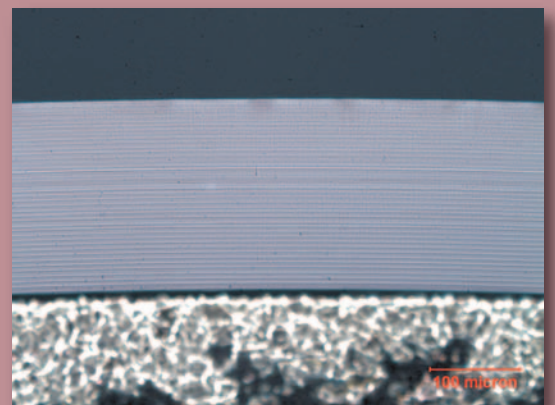


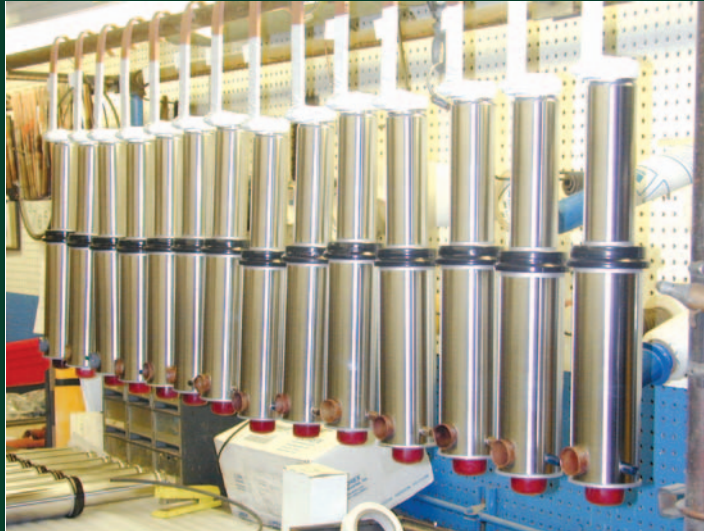
Figure 4. Cross-Section of ENhanced HPO

# Leave The Masking To Us!

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What materials will you use for the stop-off paint, tape and plugs? Since specific solutions are more compatible with certain masking materials, the skill and judgment of our staff comes into play. If an incorrect decision is made at Anoplate regarding the choice of masking materials, we absorb the rework charges. Our masking repertoire includes over six different stop-off paints, two dozen different shapes, backing material and adhesive tapes and hundreds of different designs and materials of various plugs and caps. There are so many plug styles that they've taken on their own names such as rat tails, dunce caps, and comp-u-plugs.

On certain repeat jobs, it may be possible to develop a specially designed, molded plug that handles several areas at once. What's becoming more commonplace is for one of our Industrial Engineers to design a reusable, non-consumable mechanical enclosure that while costly upfront, results in more consistent transition lines, less waste and lower unit cost to the customer in the long run.



Masking

Several members of our masking team have over 25 years of experience and they're supported by a group of industrial and process engineers who constantly review both new incoming jobs as well as repeat jobs where savings are available. In conjunction with our experienced maskers and operators, our team of engineers has developed several new, innovative methods of applying stop-off paint using a combination of proprietary polymer paint and automated dispensing equipment. Only certain high volume or very complicated repeat parts will allow the programming time required to implement using these techniques.

We hope that we have illustrated several reasons for our answer, "leave the masking to us."

Believe us; it will save you money in the long run. In closing, if your part requires any degree of masking, typically that will necessitate a longer turnaround time. If stop-off paint is involved, it takes as long to remove the paint and get the part cleaned up as it took to mask in the first place. In any case if you think masking will be required, get a sample to Mike Ortiz or Dave Edmonds so they can have our Engineering Team working on the most cost effective and shortest cycle time solution.

## AnoBlack EC

AnoBlack EC provides electrolytic blackening using inorganic metallic salts in lieu of organic dyes. A 100% smut-free coating that will not fade under extremes of light or temperature. Meets MIL-A8625, Type II, Class 2 for black sulfuric anodized aluminum.

### Applications:

- Optics/Optical
- Medical Devices
- Aerospace/Space vehicles
- Semiconductor and electronics

### Key Advantages:

- On 6000 and 7000 series aluminum, AnoBlack EC/EC7 will withstand 500F for one hour without any degradation.
- Black color is largely independent of anodic film thickness - so color depth remains consistent even on thinner coatings.

Check out our website for more information about this unique two-step blackening process for aluminum or if you'd like a copy of our new technical data sheet, please contact Sean Novak one of our Application Engineers. [snovak@anoplate.com](mailto:snovak@anoplate.com)



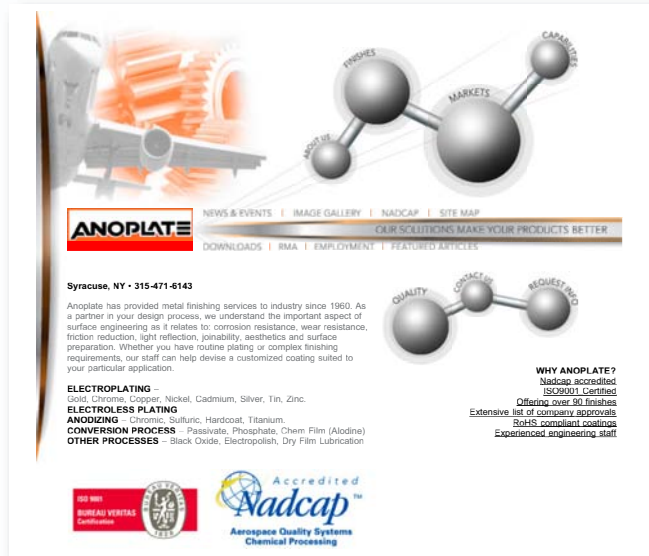
## Thickness Variability Due To Test Method

In our Summer 2006 issue of Anoplate News, we discussed the eternal problem of where does one measure the plating thickness? It is recommended that on any intricate part or long term contract, an understanding of what areas to measure and using what type of instrument be established early on.

Why do we mention the need for what instrument is to be used? Right up front most thickness determination methods are accurate within +/- 10% of their true value. A broad array of instrument methods is available: X-ray fluorescence, magnetic permeability, beta back scatter, coulometric (e.g. Kocour), eddy current, microscopic cross section, and micrometer as well as others. Each of these test methods are governed by various ASTM, ISO and NIST standards. However, it is not uncommon that any two methods will result in different results. When this does inevitably occur, who's to say what the referee method will be? At Anoplate, the preferred methods are X-Ray (XRF) for electroplated coatings, Eddy Current for anodize and Micrometers for thick coatings which exceed the upper capability limit of available instruments or electroless nickel which plates uniformly throughout the tank. Before getting into squabbles over whether or not parts meet prescribed thickness requirements, have a discussion on which method will be the referee and just where on the part the thickness criteria must be met. Such communication upfront prevents production interruptions and costly delays down the road.

# News & Events

**We Have A New Website! Please visit us at [www.Anoplate.com](http://www.Anoplate.com)** to learn more about our processes, experience and the markets we serve.



## Metal Finishing '101' Launched

Last year we conducted several metal finishing training seminars in cities and corporate locations around the country. Topics included:

- Metal finishing '101'
- Avoiding Pitfalls in Specifying and Purchasing Metal Finishing
- Innovative Solutions and Trends in Metal Finishing

These educational events received great reviews from all of our attendees:

*"It was all business. Just what you said it would be – educational, not sales."*

*"Very informative overall. I greatly appreciated the education."*

*"I would send other people from my company."*

*"Very well organized"*

*"Overall, excellent! Thank you!"*

If you are interested in having us conduct an on sight session at your facility, contact Jeff Carpenter, Anoplate Sales & Marketing Manager at: 315.471.6143 ext 151 or [jcarpenter@anoplate.com](mailto:jcarpenter@anoplate.com)

## Nadcap Scope Expanded

We are pleased to announce the expansion of our Nadcap scope for chemical processing. With over eighty (80) finishes now under accreditation by Nadcap, Anoplate stands as one of the premier metal finishers serving the Aerospace & Defense industries. From anodizing, electroplating, conversion coatings to dry film lubricants, Anoplate offers a wide range of surface treatments & finishes for the most demanding air and space applications.

## ITAR

Anoplate recently registered with the Department of State, Office of Defense Trade Controls Compliance. If you have critical defense related projects that require metal finishing, rest assured Anoplate has the systems, policies and procedures in place necessary in handling sensitive documentation and information under ITAR requirements.

# Questions & Answers

**Q** I understand that electropolishing increases the fatigue resistance of metals. Where can I find supporting data on this phenomenon?

**A** A good explanation is available in Volume 5 of the American Society of Metals Handbook, under Surface Engineering of Carbon and Alloy Steels. In there it is reported that in one instance the endurance level of a metal was increased from 120,000 cycles to over 10 million cycles without failure. One explanation for the dramatically improved fatigue strength is due to removal of compressive stresses in the outer most layer of metal.

The grain structure that is modified at the surface of part due to machining or grinding is known as the Bielby layer. This layer has been disturbed by a mechanical operation, is now locally work-hardened, and contains higher stress concentration levels than the bulk of the underlying metal. In the Journal of Materials Science: Materials in Medicine Volume 16 (2005) Pages 107-117, the authors conclude an up to 57% increase in fatigue cycles to failure in dry service conditions on 316L SS, and up to 100% improvement when exposed to wet or corrosive service conditions. The authors conclude that the increase in fatigue life was attributed to reduction in surface roughness (removal of the Bielby Layer) by the electropolish process and hence a reduction in surface stress concentration levels.

**Q** What is thermal deburring?

**A** This is a method, using thermal energy, to remove burrs and flash. Parts are placed in a furnace and a mixture of natural gas and oxygen are injected under pressure. A spark causes the mixture to ignite; forming a 6000 degree F heat wave and the thin sharp edges burst into flames and are eliminated. The main part, having a greater mass, only gets warm.

# ANOPLATE

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