ANOPLATE NEWS

The Latest News on Surface Engineering from Anoplate Corporation

Why Does Anodize Fade?

Anodized aluminum is for the most part a robust, quality finish that is readily obtained through any number of chemical processing houses. However, a persistent issue that arises is fading of colored anodize. The fact is, there are a number of causes for this — not always related to the processing houses cutting corners — so we thought we'd review some of them.

To begin with, anodic coatings are porous by nature and freshly anodized surfaces act as great receptors for dyestuffs, typically organic compounds available in a myriad of colors. (See figure 1 of anodic growth on page 3.) The organic dyes used to impart color to freshly-formed anodic coatings are the same as those used to dye textiles. All such dyes are rated from 1-10 for fastness which relates to a particular dye's ability to withstand exposure without degradation. The dyes used in anodizing are graded accordingly for their ability to hold up to light (particularly UV), heat and chemicals. Depending on a part's application, if it is to be used on the exterior of an auto for example, one would be best off specifying a dye with a light fastness rating of 8 or better. On the other hand, if it's an electrical connector on a power supply that is going to be used inside, but is subjected to heat upwards of 400°F, a higher heat fastness rating may be more critical. In general, basic black dyes are formulated to give adequate protection across the board. But specific colors like turquoise or pink may not provide equal protection across all three: light, heat and chemical.

While porous, once dyed the anodic structure needs to be sealed so that the pores retain the dye. Sealing of dyed anodize is typically done using an elevated temperature solution of nickel acetate which hydrates the aluminum

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50 YEARS ANOPLATE

World-Class Surface Engineering

Fall 2015

Silver: Precious in More Ways than One

A metal finish that offers desirable properties in even the most ancient of uses

Around 327 BC — having defeated Persia, Egypt, and Phoenicia — Alexander the Great's indomitable army was about to advance on India when a mysterious gastrointestinal ailment broke out among the troops, yet inexplicably spared the commanders.

Why were the commanders unaffected?

Because the common soldiers used tin cups, while the commanders used silver ones - and as modern science has proven, even small amounts of silver (a few thousand-millionths of a gram) are enough to purify a quart of water of harmful bacteria.

A high-voltage bus bar for an electrical generation plant being silver plated

In more modern times — and specifically in certain industrial finishing applications — silver can be just as valuable, and not merely for its dollar-value as a precious element of jewelry, flatware, and other items that are either solid silver or silver plated.

In addition to its purifying and aesthetic qualities, silver offers unmatched ductility or "stretch-ability." In fact, under perfectly controlled conditions, a one-gram grain of silver can be drawn out into a single piece of wire stretching nearly a full mile. Furthermore, when it comes to electrical conductivity, high-temperature lubricity, joinability, and resistance against cold-welding, silver plating offers surface enhancements that no other metal can provide.

Considered next are a few real-life applications in which silver plays a crucial role.

Silver in Electronics

Of all metals, silver is the most electrically conductive. It's preferred in a wide range of electronic applications, from radar and sonar equipment to communication devices.

Silver plating is the key to successful refurbishing of worn or degraded high-voltage-carrying bus bars for electrical-generating facilities, including nuclear power stations. Currently, Anoplate is consulting with a utility about the use of brush plating to repair damaged silver connections on-site at the utility's generating plant. Transmission line filters also rely on silver. Specifically, they rely on its high conductivity, which helps to minimize dissipation losses. Because of the frequencies at which transmission line filters operate, most of the currents flow on the surface of resonators and their cavities. This allows the use of inexpensive, low-conductivity metals to be plated with a high-conductivity metal like silver.

In such an application, because the silver plating is thicker than the depth at which the current flows, the filters "act' as if they're made entirely of silver, reducing dissipation and increasing the cost-effectiveness of plating at the same time.

Aerospace Applications

Bearings of most types – and particularly those used in aircraft engines - require silver plating due to its inherent lubricity at high temperatures and its resistance to seizing, even while operating at very high loads.

Similarly, aircraft engine igniters (called "spark plugs" in automobiles) are typically manufactured from threaded stainless steel components. Without silver plating of the threads, the stainless steel would cold-freeze to its mating metal surface, making replacement impossible. Since igniters are replaced at regular intervals based on the number of flight hours, silver plating of their threads is critical not only to proper functioning of the igniter but to the life of the entire aircraft engine as well.

Silver in Consumer Products

Throughout the '70s and '80s, the world's leading manufacturer of room air conditioners contracted to have thousands of copper tubes silver-plated. The silver finish was important because it allowed hermetic sealing by brazing of the coils and tubes. A break in the silver due to stress cracking, pits, or poor adhesion would have resulted in refrigerant leaks and an inoperable air conditioner.

Silver plating is fundamental to the performance of a host of other consumer products, too - radios, TVs, video games, telephones, stereo equipment, VCRs, and more - due primarily to the metal's high electrical conductivity.

When you mention silver, people outside of industry usually think of hollowware, flatware, rings, necklaces, and the like. (Even among metal finishers, few are likely to think of Alexander the Great.) Silver has an obvious appeal as a precious substance in art objects and jewelry - but it can be just as precious in a less obvious, industrial sense.

•••*continued from Page 1*

oxide forming a boehmite and in essence swells the tops of the pores shut so the coloration is retained. Skipping this critical step will greatly increase the likelihood that one's anodize will degrade ... sometimes within days! It isn't always that the anodizing house is skipping over the seal, as poor process control over sealing conditions can compromise the solution's ability to seal the anodize. Temperature, concentration, immersion time and purity are all necessary to be monitored and controlled. A simple "seal integrity test" per ASTM B136 can detect whether a part has been sufficiently sealed or not. Actually, anything that stains (coffee works great!) can be used similarly. Another "smoking gun" characteristic of unsealed or poorly sealed anodize is, when squeezed, the coating feels sticky due to millions of nanoscale suction cups are adhering to your touch.

One way to get around fading of anodize is to use inorganic coloring techniques. One particular choice is gold dye which is ferric ammonium oxalate and not subject to fading upon light exposure. Another option is to use electrolytic coloring which, unlike pigmenting the oxide layer, utilizes metal bearing salts which result in adsorption and reflection of particular bands of lightwaves resulting in different coloration effects. Anoplate's *AnoBlack EC* is such a proven technique of blackening anodize such that it can withstand not only the rigors of sterilization on medical devices, but also the temperature extremes of deep space on satellites. Developed nearly two decades ago, dozens of satellites and space flight hardware depend on fast black *AnoBlack EC* to provide consistent, uniform optical properties and thermal image for their critical missions.

Lastly, when it comes to hardcoat anodize and fading, it could be the result of the specification being somewhat ambiguous when it comes to sealing. While most hardcoat is somewhat dark colored as deposited, it typically isn't dyed. Many optical, medical and military applications require it to be fully black, thus dyed. Sealing hardcoat anodize in an elevated temperature solution reduces the abrasion resistance of the coating, one of the principal desired properties it is often applied for. As such, MIL-A-8625 for Type III hardcoat anodize applications states that "unless otherwise specified the coating shall be unsealed." The question then becomes, by specifying Class 2 for a dyed black coating, does this imply "otherwise specified"? Anoplate's interpretation of this is that by specifying application of a dye, this in essence is specifying sealing, as there is no case where supplying a dyed, unsealed anodic coating is adviseable. Doing so leads to outgassing, dye residue retained on the surface and fading. There are many factors that can lead to fading, but we're not going to permit a specification to be an excuse! Solid process control, quality products and suppliers, and standardized procedures will result in colored anodic coatings that will stand the test of time and exposure.

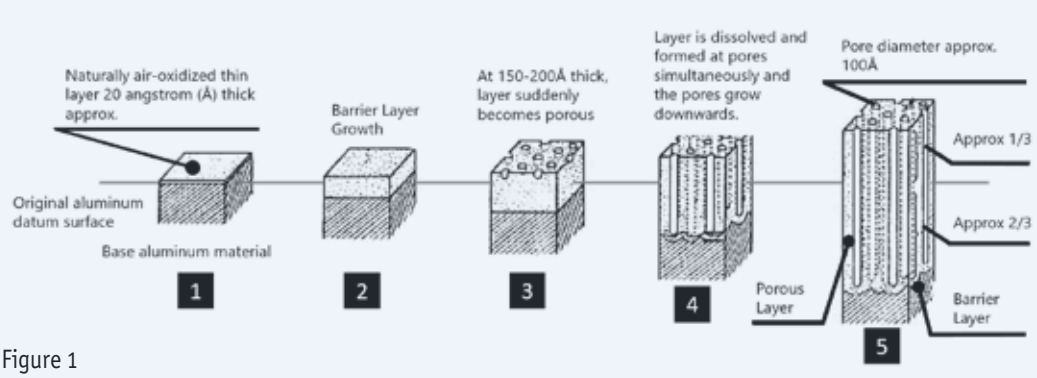


Figure 1

Q&A

Q. *I have some cast aluminum (355 T6) parts in question that have been anodized but have issues with porosity. Can impregnation be done on these parts to correct the condition in an anodized state? Would we need to re-anodize after impregnation?*

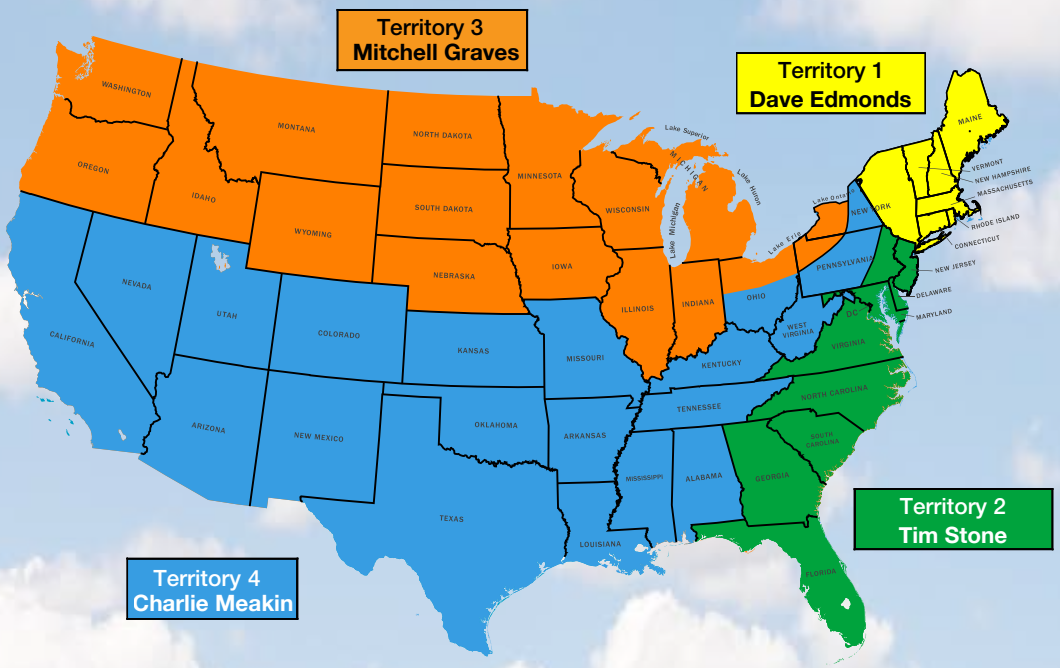
A: The reason you're seeing porosity after anodize is that during processing the pores adsorbed the anodize electrolyte — namely sulfuric acid. And if your parts are dyed, we're sure the acid is leeching the dye, making the pores even more noticeable. The parts can be impregnated-post anodize ... however, this type of approach is less effective (if not frowned upon) as: (1) the entrapped electrolyte and chemicals inhibit the impregnant resin from penetrating as deep as it might have otherwise penetrated and (2) impregnating post-anodize entraps those acid 'corrodents' in the part and should they be released later on, this can result in significant corrosion.

That said, they can be impregnated after anodize but we wouldn't recommend it. Better to strip, impregnate and re-anodize, *but* there may be dimensional consideration that would be impacted. We would also recommend a mask for bushing holes or threaded features to prevent them from being stripped.

Meet Your Anoplate Outside Sales Representatives

Anoplate has recently expanded its Outside Sales Team. Each member is dedicated to serving our customers and introducing our services to new markets. Whatever your metal finishing needs, our sales representatives will partner with you to obtain a quality product while providing a great customer experience.

(L to R) Dave Edmonds (Outside Sales), Charlie Meakin (Outside Sales), Mitch Graves (Outside Sales), Tim Stone (VP of Business Development), Jim Stevenson (Anoplate CEO).



ANOPLATE NEWS
Fall 2015

A publication of
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