Aluminum Anodizers Council
TM

TECHNICAL BULLETIN #7-13

"Deoxidizing"

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Aluminum Anodizers Council • 1000 N. Rand Road, #214 • Wauconda, IL 60084 USA
Tel: 847/526-2010 • Fax: 847/526-3993 • mail@anodizing.org • www.anodizing.org

#7-13 replaces #3-99 "*Smut on Anodized Parts*"

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DEOXIDIZING

Organic Dyeing

Colors produced using organic dyes are the most widely used products in the trade. The most common smut problems associated with these occur when using black dyes because the deep black color provides an ideal background for showing the smut.

Most often, the smut results from improper use of the sealing products. All organic dyes, with the exception of Sanodal Deep Black MLW, must be sealed using Nickel Acetate. The Nickel Acetate prevents the bleeding of dye (outward migration of the absorbed dye into the seal tank). The Nickel also causes the formation of Nickel Salts on the surface, which further aggravate smut formation.

Another problem quite often observed on parts that have been dyed is the presence of particulate matter on the edges and on scratched and burred surfaces. This problem is common if there is chloride contamination in the dye tank.

Yet another problem that occurs on dyed parts is staining that is not removed in the rinse tanks or seal tanks. This effect is specific with some dyes but not with others and is related to aluminum contamination of the dye. When this happens the only solution is to dispose of the dye solution in the tank.

Sealing

Most smut problems that occur during this process are a consequence of either a poor sealing product or inadequate maintenance of the seal tank. To understand smut produced during this process, it is important to consider both hydrothermal seals and cold seals separately.

During hydrothermal sealing the anhydrous coating is hydrated, causing the formation of Boehmite crystals, which are not easily perceived on clear and light-colored finishes. On dark surfaces, especially black, these Boehmite crystals appear as a heavy velvety film. This film can be controlled by either reactive chemistry or by surface-active chemistry.

Reactive chemistry treatment halts the formation of the Boehmite at the surface by blocking the process of hydration. This method is not very popular in the U.S. due to the time required and the high-energy costs involved. This is, however, the method of choice for sealing in Europe. Very few chemicals are available for this purpose and care should be taken in their selection. One significant advantage of this method is that it offers the best adhesion of organic matter to the anodic coating (e.g., paint, caulking, seals). With this method it is also possible to avoid a final rinse tank. This method of sealing does not work with Nickel-based products because the chemical is not able to prevent the formation of Nickel Salts on the surface.

When surface-active chemistry is used, the formation of Boehmite on the surface is minimized or eliminated because the surface tension is altered, thus preventing the formation of the Boehmite at the surface. This method requires a final rinse because of the surfactant and Nickel residues.

One of the biggest disadvantages of this method is that the surfactants used to

control smut themselves break down and start to stain the parts. This can be minimized by filtration, but breakdown of surfactant inevitably causes sealing problems. Most anodizers do not consider this when using hot Nickel seals because, until recently, there were no analytical procedures for checking the organic component of the seal. Today, however, there are methods that can accurately measure the organic content and help anodizers produce smut-free parts.

It is important to consider that when using hot Nickel Acetate seals, Nickel Salt deposits (generally white and powdery), Boehmite (heavy velvety) and surfactant stains (like water stains and foam marks) may cause smut. If the smut wipes off with a wet rag then it is most likely surfactants stain. The other two forms of smut are generally more tenacious and need some abrasive action using pumice or a plastic scouring pad.

Some European anodizers that operate hot water seals continuously recirculate the seal through a filter to remove any aluminum hydroxide precipitate suspended in solution. Otherwise it can end up on the work as a white particulate.

Cold seals typically do not cause the classic sealing smut problems (staining, white film, etc.) in the seal tank, generally resulting in a smut-free finish. The only smut problems that occur using this method are as a result of pH fluctuations and/or excess Fluoride. When this does occur, the parts look iridescent. This difficult smut cannot be removed merely by wiping with a wet cloth. In addition, most cold seals must be followed by a hot seal to ensure best results and this hot-water final treatment can result in smut that is similar to hot-water hydration seals. It is common practice to add seal additives to this final hot seal to prevent smut.

Weathering Bloom

Anodic coatings will continue to hydrate in the environment. During service, some parts (particularly architectural profiles and sheets) tend to develop an iridescent smut that is almost similar to the smut produced from hot-water sealing. This problem is very obvious on buildings and storefronts where the anodized finish is never treated or cleaned after installation. This effect is one of the most misunderstood phenomena in the architectural business in the U.S.

The solution is to develop a maintenance schedule that involves periodic mild abrasive cleaning of the surface.

SMUT ON ANODIZED PARTS

Throughout the aluminum anodizing industry, *smut*, is among the most difficult phenomena to understand, let alone explain to a customer. Smut is considered by many to be the most dreaded word in the business. It is important, therefore, to understand the common processes through which smut can occur, as well as some simple means of evaluation and treatment.

Smut is used loosely to refer to any residue left on the surface of the aluminum as a result of some form of chemical treatment. In some cases it may be present but not very visible; in other cases it may be very prominent. It is often ignored until the appearance of the finished product is seriously impaired. It can derive from various process tanks under various circumstances.

Alkaline Cleaning

Today alkaline cleaners rarely cause smut because most are now non-etching. In some cases, etching may result from the use of aggressive cleaning methods employed to remove difficult soils. This form of etching is generally mild and the effect is that of staining the part; however, if the etch is aggressive it can leave a smut residue. Subsequent processing usually removes this smut and rarely, if ever, does it show up on the finished product.

Alkaline Etching

This process always produces smut. In fact, the smut produced during this process has a very significant benefit for job shops. The smut produced during etching has a different color and/or pattern depending on the alloy and the temper (heat treatment) of the part. Therefore, the etch pattern and smut can be used to identify metallurgical variations of the parts. This, in turn, is very important to know because different alloys produce different coating characteristics like color and opacity. Every metallurgical variation or defect can be identified by this step and good anodizers are able to use this to their advantage.

The temper of the alloy can also cause alloying constituents to migrate, which, in turn, can produce a smut that is hard to remove in a conventional desmut operation.

Desmut/Deoxidize

This process removes the smut produced during the etching process. Good desmutters generally remove all of the smut from the etching process and yield a surface that is near perfect and devoid of residue. In some instances, a part in the T-52 temper will appear to be free of smut, but a detailed examination will reveal some tenacious Magnesium Silicide residue.

A good test to determine if the part is smut-free after the desmut process is to rub a moist white paper towel along the part. If the towel is stained, then the part is not desmutted adequately.

Anodizing

This tank can produce smut, especially under improper anodizing conditions. When this happens, the coating is very powdery. Reasons for this can be any, or a combination of, the following:

- High Temperature Anodizing
- Very Low Current Density
- Very Long Anodizing Time.

Coloring Processes are Examined Under the Following Three Categories:

- Chemical Dyeing
- Electrolytic Coloring
- Organic Dyeing

Chemical Dyeing

The most common colors produced using this technique are the gold shades using Ferric Ammonium Oxalate (FAO) or Ferric Sodium Oxalate (FSO). This bath has a tendency to become turbid (cloudy) during daily use. When the bath is turbid, it tends to color at a faster rate and long treatment times will result in a yellow to orange dust on the part. This can be perceived to be smut, especially if the seal tank is not able to disperse this residue.

Electrolytic Coloring

Colors produced by this method are very popular in architectural applications. Smut can be produced in this process if the bath is not filtered or improperly filtered (using the wrong size cartridges). In this case, the Stannic Sulfate will form a fine yellow particulate matter in the bath that may cling onto certain surfaces that are covered with solution when the parts are removed from the bath. This particulate matter, which looks like dust, often can be seen after the sealing process.

Another source of electrolytic smut can be a phenomenon called overplating. When producing a black color, it is sometimes possible to completely fill the pore and leave a deposit of metallic tin on the surface. This smut is grey and very tenacious. Some industry observers recommend removing this smut by treating the parts with an acidic rinse (rinse after anodizing tank). However, acidic dissolution could degrade the coating itself, which could lead to unsatisfactory weathering performance. Anodizers should establish conditions – including appropriate film thickness – to avoid overplating.