



How One Packaging Manufacturer Handles Environmental Requirements & Safety Issues

By William B. Rusch, President

Anodizing, the electrochemical oxidation of aluminum, is widely used throughout the world for a variety of functional and decorative applications. In anodizing, a thin film of aluminum oxide forms on the surface of the aluminum part and acts as a barrier against further natural oxidation or corrosion.

Before it is anodized, the aluminum is treated in a variety of chemical baths to yield a bright, semibright, or matte surface finish. Then the prepared aluminum surface enters the anodizing bath, where a sulfuric acid electrolyte is present with a low-voltage DC charge, resulting in an electrolytic reaction and the formation of the oxide layer. This film subsequently can be colored using aqueous dyestuffs that are absorbed into the porous structure, and then finally sealed in boiling deionized water. The result is a decorative and durable finish. Anodizing is scratch-resistant and will not flake, peel, or fade and is suitable for high-speed bowl feeding applications.

Anodizing has been called the “green,” or environmentally friendly, finish in the metal finishing field for some time. The process releases few toxins into the environment, uses almost no heavy metals, and uses chemicals and metals that are recycled easily. Finished products made from anodized aluminum are nontoxic and safe to use in many packaging applications for consumer products, including cosmetics and beverages.

Over the past several decades, cosmetics container manufacturers have significantly reduced the use of buff and lacquered finishes, which produce solvent emissions as a byproduct, or plated finishes, which utilize heavy metals and have residual hazardous wastes, and changed to anodized aluminum finishes. Nearly all major cosmetics packaging manufacturers routinely use anodized finishes in their metal packaging applications.

Anomatic Corp. is one such container manufacturer. The anodized aluminum components it designs and manufactures are for packaging fragrance and lotion pumps, treatment caps and closures, mascaras, lipsticks, and eyeliner pencils, to name a few.

The company’s core philosophy is that manufacturing products at the expense of harming the environment is not acceptable. In line with this



philosophy, the company has made a significant, long-term commitment to protect the environment through state-of-the-art waste treatment and recycling processes.

Selecting Aluminum

The manufacture of an anodized aluminum component at Anomatic begins with the choice of base metal and alloy. Aluminum is the most commercially recyclable metal used today. Because recycled aluminum is already in the metallic state, all of the energy spent purifying the ore and reducing it to metal is saved when it is recycled. Simply melting the aluminum renders it usable again. All scrap parts at Anomatic (rejects for visual or dimensional nonconformance) are sent to local recycling facilities. In addition, the aluminum trim that comes off the stamping operation also is sent out for recycling.

While most products the company produces are made with conventional base alloys such as 5657 and 9020, some cosmetics packaging manufacturers have begun to specify recycled aluminum alloys such as 3004. Anomatic is participating in this initiative. Caution is warranted because recycled aluminum can contain heavy metals, particularly lead and cadmium. Heavy metals are a concern because the preanodizing finish steps entail metal removal, so these metals can end up in the wastewater discharge. The Coalition of Northeastern Governors (CONEG) limits are 100 parts per million (PPM) for the total of listed metals. Many of the recycled alloys have higher concentrations of the listed metals resulting from poor segregation of heavy metal sources from the aluminum scrap. However, with proper selection criteria, the recycled alloy can be used in conformance with CONEG limits.

Stamping and Degreasing

The fabrication step involves deep drawing aluminum coil stock into various shapes and sizes using high-speed transfer presses. The stamping oils are easily captured and reused. Oil-laden scrap is spun through a centrifugal chip wringer, and then the clean scrap is sent out for recycling while the oil is reused in the presses.

The stamped products go through aqueous degreasers, where the oils are captured through ultra filtration and coalescing filters, then sent to a fuels blending program. Because no solvents of any kind are used in the degreasing operation, the captured stamping oils are non-hazardous and easily blended into fuel oil. The stamping and degreasing processes produce no emissions or hazardous waste.



Anodizing

Several inorganic acids (nitric, sulfuric, and phosphoric) are used in the anodizing process. The acids are rinsed from the aluminum parts between the process steps to prevent bath contamination. Aluminum metal is dissolved in these acid baths.

The acidic rinse water must be treated before being discharged to the local wastewater treatment plant. Solids are removed using conventional hydroxide precipitation followed by clarification and filtration. The filter press produces a solid cake of aluminum hydroxide that is nonhazardous waste and is sent to a landfill. The clarified rinse water is neutralized and sent to the sanitary sewer system.

All effluent leaving the company is monitored using a continuous-sampling device that operates 24 hours a day, 365 days a year. An on-site, EPA-certified chemical laboratory that uses wet chemistry analysis and metals testing equipment is staffed by trained technicians during production hours. Effluent purity test results are shared daily with the local wastewater treatment facility.

Nickel is the one regulated heavy metal used in Anomatic's anodizing process. The nickel comes from the dilute solution of nickel acetate used in the sealing process, in which the anodic pore is closed (sealed) through hydrolysis. The rinse water from the sealing step is segregated and put through a separate nickel treatment system. The nickel metal is removed from the effluent through metal hydroxide precipitation followed by clarification and filtration. The resulting cake of nickel hydroxide is sent off-site to a nickel smelter for recycling. This anodizing process produces no residual hazardous wastes.

Finally, all acidic air emissions are captured and thoroughly cleaned by scrubbing systems, which are permitted and tested routinely by the Ohio EPA. Nitrous oxide (NO_x) gases produced by the chemical brightening baths are chemically converted to nitrogen gas and water vapor. Acid gases are neutralized and odors eliminated through multistage packed tower scrubbers using high-pH caustic absorption.

Recycling

In addition to its efforts in recycling aluminum, stamping oils, and nickel metal, the company also has sophisticated processes and programs for recycling phosphoric acid and titanium scrap.



Its phosphoric acid recycling system uses ion exchange and vacuum separation equipment to purify and reuse phosphoric acid water segregated at the anodizing lines. More than 85 percent of all the phosphoric acid is recycled, thereby preventing large-scale phosphate contamination of downstream water systems.

Titanium is used in Anomatic's proprietary conveyor belt system and in its anodizing racks. As belts and racks wear out over time, the titanium scrap is captured and sold back to the titanium mills for reuse.

Safety Issues

Anomatic's anodizing process contains none of the regulated heavy metals (chromium VI, lead, mercury, cadmium, barium, arsenic, and selenium) as outlined by Z66.1-1964 (toy safety regulations), 16 CFR 1303 Consumer Product Safety Commission, ASTM F 963 (consumer safety specifications on toy safety), CONEG Heavy Metals Legislation, and Proposition 65.

The only heavy metals the company uses are nickel II (used in the sealing process) and chromium III (dyestuffs). The nickel hydroxide in the anodic coating is in microscopic concentrations and is either chemically bound to the anodic pore or precipitated inside the pores. It is stable both chemically and physically, and it is insoluble in water so it cannot be dissolved. Trivalent chromium is a naturally occurring form of chromium that is an essential element in our diets and is present in vitamin supplements. The chromium in the dyes used at Anomatic contains chromium III, not the toxic chromium IV. The chromium III dyes generally are regarded as safe and are completely sealed inside the anodized aluminum coating, preventing contact or degradation.

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