

## **Bectropolishing:** Process Considerations

Bectropolishing has been commercially used since the 1950s. It continues to be a very popular surface finishing process geared to achieving specific surface treatments on a wide variety of metals. The net result

important aspects.

Bectropolishing replaces traditional mechanical treatments, such as milling, blasting, grinding, and polishing. Several of the benefits of electropolishing include:

Reduce labor-intensive operations.

- 1. An excellent procedure to streamline and smoothen microscopic surfaces.
- 2. Polishing and deburring are accomplished in a single step.
- 3. Burrs, typically of less than 0.005 inches in size, are removed. It allows for greater bulk processing of parts. What you get is a dean, even surface finish. It is one of the best surface polishing methods.
- 4. Sterilization is enhanced for medical and pharmaceutical applications.
- 5. Passivation of stainless steels to optimize corrosion resistance is excellent.
- 6. Other exceptional results include removing oxides and tarnish, producing a uniform surface (aesthetic appearance), reducing friction and galling, producing a desired microhardness, increasing magnetism, and improving welding and brazing.

There is a wide range of industries that achieve excellent results using electropolishing, including:

- general fabrication
- marine
- aerospace
- automotive
- pharmaceutical & medical
- petrochemical
- food & beverage service
- furniture and appliance

Over the years, different electrolytes have been developed that can electropolish many metals and alloys, including stainless steels (300 & 400 series), aluminum, brass, copper, bronze, nickel, steel, titanium, Inconel, Hastelloy, gold, silver, and Kovar,

fully

immersed in a special acidic electrolyte. Ancillary equipment, such as bussing, heaters, anode & cathode bars, DC rectifiers, and agitation, are similar to traditional electroplating. With current applied at specific current densities for a pre-determined time, anodic oxidation dissolves metal off the substrate surface. It is essentially a controlled, accelerated corrosion of the part. Optimum electropolishing is achieved per the traditional operating parameters (current, time, temperature) and bath chemistry, racking, positioning, and part-to-cathode distance.

The bath is a mixture of acids, such as sulfuric and phosphoric, and other agents saturated with dissolved metal salts a chemical equilibrium forms, with precipitated metals as sludge. The sludge is periodically decanted, and some of the electrolytes are replaced to maintain a specific solution with specific gravity. The ampere-hours. It becomes thicker,

taking on the properties of an insulator or resistor. With applied current and focusing on the direct surface to the immediate solution interface, the solution film thickness increases, thereby insulating the high current density areas of the part surface. This section of the part becomes less active. In the low current densities, the solution film thickness decreases, resulting in a less insulated or more active portion of the part. This comparison of surface activities leads to normalizing microscopic peaks to valleys, dramatically improving the surface leveling characteristics.

Other benefits occur during the electropolishing treatment. Hydrogen is removed from the surface of parts, providing a stress-relieving anneal. Oxygen evolves at the part (anode), forming an agitation medium. This refreshes the electrolyte film surrounding the part. Electrical charges are greatest at edges or sharpened, irregular points. That is why electropolishing is an excellent deburring application. These areas exhibit greater electromotive potential. In the opposite picture, valleys or low current density areas exhibit less electromotive potential. This electromotive potential controls the electropolishing dynamics.

There is a significant preference to remove high spots on the surface, resulting in a dramatic change of dimensions to high spots. Consequently, there is less change in the dimension of low spots. The result is an overall smoothening effect on the metal surface. Compared to mechanical treatments, the dimensional change in electropolishing is small to obtain the desired polishing effect. The overall dimensional change to a part can be 0.00025 inches. A general rule is that large flat surfaces tend to produce satin or refractive finishes. Smaller parts or those with a radius of curvature tend to produce reflective mirror finishes the more curve to surface results in a brighter polishing effect.



The following are some terms relevant to electropolishing and post-evaluation of the surface of conditioned parts.

- Surface Roughness Ra (roughness average) or RMS (root mean square) is measured in micro inches. It is a quantitative measure of smoothness of finished surfaces.
- Surface Chemical Analysis A determination of contaminant levels or the effect of decontamination, resulting in desired surface purity.
- Surface Chromium Enrichment For passivation, where the chromium concentration exceeds iron, as a ratio in the surface layer. For corrosion improvement.



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