

What is Electropolishing?

- ① Electropolishing is an anodic dissolution process in which the metallic anode surface is smoothed and brightened under optimum conditions of current density and temperature.
- ② A method of polishing metal surfaces by applying an electric current through an electrolytic bath in a process that is the reverse of plating.
- ③ An electrolytic method of producing simultaneous brightening, smoothing, deburring, cleaning, and passivation on stainless steels.

What is Electropolishing?

Electropolishing is a process of removing metal from a work piece by the passage of electric current while the work is submerged in a specially designed electrolyte. The process is essentially the reverse of electroplating. In a plating system, metal ions are deposited from the solution onto the work piece; in an electropolishing system, the work piece itself is dissolved, adding metal ions to the solution.

The work piece is connected to the positive (or anodic) terminal, while the negative (cathodic) terminal is connected to a suitable conductor. Both positive and negative terminals are submerged in the electrolyte, forming a complete electrical circuit. The current applied is direct (DC) current.

The quantity of metal removed from the work piece is proportional to the amount of current applied and the time. In the course of electropolishing, burrs and other projections become very high current density areas and are rapidly dissolved. The work piece is manipulated to control the amount of metal removal so that dimensional tolerances are maintained.

In the case of stainless steel alloys, an important effect is caused by differences in the rates of removal of the components of the alloy. Iron and nickel atoms are more easily extracted from the crystal lattice than are chromium atoms. The electropolishing process removes the nickel and the iron preferentially, leaving a surface rich in chromium. This phenomenon imparts the important property of "passivation" to electropolished surfaces.

Why is Electropolishing Used?

- ① Burr Removal
- ② Decorative Finishing
- ③ Improved Corrosion Resistance
- ④ Improved Adhesion of Plated Deposits
- ⑤ Sanitary and Bacteria Resistant Finish
- ⑥ Improved Cleanability
- ⑦ Passivation

Reasons for Electropolishing

Many products are electropolished simply to remove fine burrs from stampings, machined surfaces, perforated sheet, and many other types of products. For large burrs, some mechanical grinding may be required prior to electropolishing.

Electropolishing produces excellent decorative finishes for a wide range of stainless steel automotive, appliance, and household products. The surface produced combines attractive appearance with improved corrosion resistance.

Electropolishing improves corrosion resistance by reducing surface area, eliminating occlusions, reducing free iron, and producing a passivating film of a corrosion-resistant chromium oxide. The special properties of the oxide layer are of great importance in semiconductor and pharmaceutical applications requiring a clean, sanitary surface with little or no tendency to react with a liquid or gaseous chemical environment.

Some steel products, such as textile rolls, are electropolished prior to being plated with hard chrome. The smoothing and leveling effect of the electropolishing causes the chromium to deposit in a more regular fashion, improving the properties of the plate and strengthening the bond with the substrate steel.

Electropolishing also finds application in products requiring smooth, low-friction operation. Products such as powdered pharmaceuticals, dyes, and other dry chemicals are processed with minimal losses due to the low friction surface produced.

A major application for electropolishing is in equipment for the manufacture and packaging of food, beverage, and pharmaceutical products. The processing equipment is regularly treated with "clean-in-place" chemicals to remove traces of product between batches and to maintain sanitary conditions. Electropolished stainless steel offers a surface which is readily cleaned by such processes.

Benefits of Electropolishing

- ① EP does something for stainless steel which can't be done any other way.
- ② Simultaneously:
 - Deburrs
 - Smoothes
 - Brightens
 - Passivates
 - Redefines oxide layer
 - Removes surface contaminants

Benefits of Electropolishing

Electropolishing produces a combination of properties which can be achieved by no other method of surface finishing.

Mechanical grinding, belting, and buffing can produce beautiful mirror-like results on stainless steel, but the processes are labor intensive and leave the surface layer distorted, highly stressed, and contaminated with grinding media and metallic particles.

The passivation methods commonly employed produce clean, corrosion resistant surfaces, but do not achieve the bright, lustrous appearance obtained by electropolishing. The corrosion resistance of electropolished stainless steel exceeds that of standard passivation processes.

Electroplating can produce extremely bright finishes, but the finish is a coating which can chip or wear off. Electroplated surfaces may also exhibit hydrogen embrittlement which must be stress-relieved in a separate step. Neither passivation nor electroplating can accomplish significant burr removal.

Processes are available for chemical deburring and brightening of steel and stainless steel, but these methods cannot match the overall surface improvement produced by electropolishing.