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What is Electropolishing?

Electropolishing removes metal from a workpiece by passing an electric current while the workpiece is submerged in an electrolyte of a specific composition. 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 WORKPIECE ITSELF IS ERODED, ADDING METAL IONS TO THE SOLUTION.

A typical electropolishing system consists of a power supply, cathodes, anode, heater housed in a tank suspended in an electrolyte solution. (See Figure A).

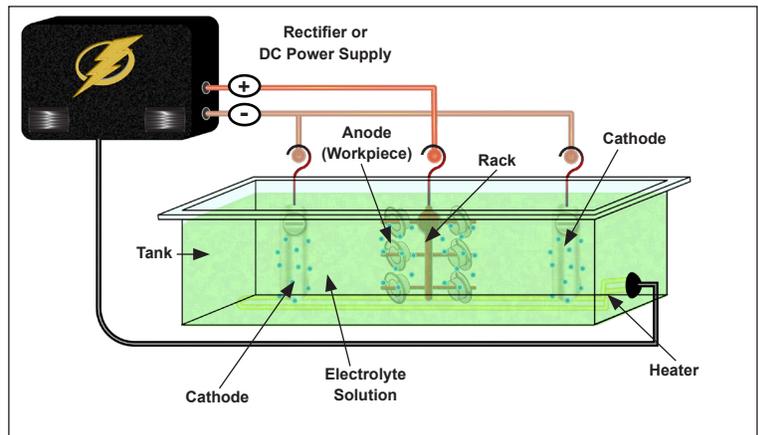


Figure A. A typical electropolishing system.

The Benefits of Electropolishing Services

Electropolishing removes elemental Iron from the surface of stainless steel alloys, enhancing the Chromium/Nickel content resulting in dramatically improved resistance to corrosion.

Electropolishing improves the near surface chemistry of stainless steel. Not only does it remove embedded particles and inclusions, it also improves the atomic ratios of the material’s alloying elements. Electropolishing preferentially dissolves Iron from the material and leaves the surface with a higher relative concentration of Chromium. Upon exposure to Oxygen, this improved surface will form a thicker and more uniform oxide layer with enhanced corrosion resistance properties. Electropolished stainless steels are better suited to resist the onset of pitting corrosion, crevice corrosion, stress corrosion cracking, and microbiologically influenced corrosion.

Electropolishing improves surface smoothness by leveling micro peaks and valleys resulting in easier sterilization.

Improved micro finishes can do more than improve the appearance of a part, it eliminates potential traps for corrosive elements. The electropolishing process may improve a surface finish reading by up to 50% (See Figure B). Because electropolishing is not a surface coating, there is no risk of the surface distorting or peeling over time, unlike spray on surface treatments sometimes used to improve stainless surfaces.

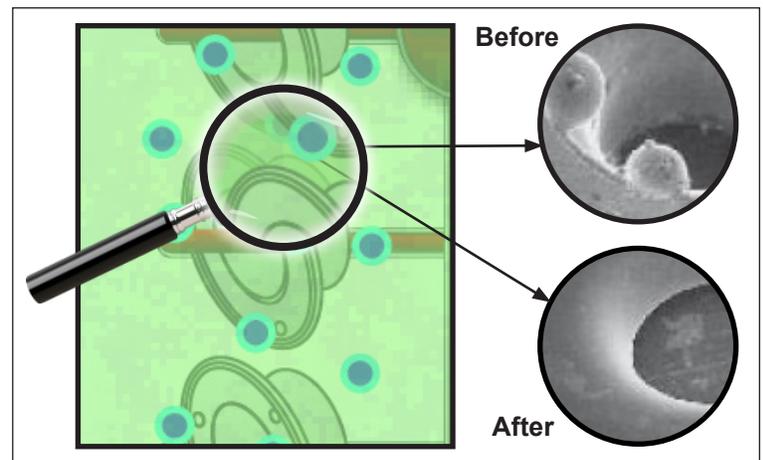


Figure B. Under magnification the workpiece surface **BEFORE** and **AFTER** the electropolishing process. Electropolishing eliminates potential traps for corrosive elements to form.

Electropolishing provides the most superior form of passivation in stainless steel.

Electropolishing removes surface material and, with it, surface contaminants. The process dissolves free Iron, inclusions and embedded particles from the surface. Electropolishing preferentially dissolves Iron from the material and leaves the surface with a higher relative concentration of Chromium. Upon exposure to Oxygen, this improved surface will form a thicker and more uniform oxide layer with enhanced corrosion resistance properties. As a result, electropolishing provides maximum corrosion resistance in stainless steel.

Electropolished stainless steels are better suited to resist the onset of pitting corrosion, crevice corrosion, localized galvanic corrosion, stress corrosion cracking and microbiologically influenced corrosion (See Figure C).

Electropolishing improves surface brightness and reflectivity.

The most visible benefit of electropolishing is the resulting lustrous surface. Electropolishing is a non-mechanical process. No tools come in contact with the piece so there is no risk of creating directional polishing lines. The material is treated electrochemically, leaving a microscopically smooth surface that is highly lustrous.

Electropolishing removes metallic and non-metallic inclusions unavoidably introduced during manufacturing.

Mechanical cutting, machining, handling and polishing will leave Iron and abrasive particles embedded within a material surface. These surface contaminants disrupt the formation of stainless steels' (and other corrosion resistant materials) naturally corrosion resistant oxide layer and are the origin of future corrosion. Electropolishing removes surface material and, with it, surface contaminants. Electropolishing dissolves free Iron, inclusions, and embedded particles from the surface.

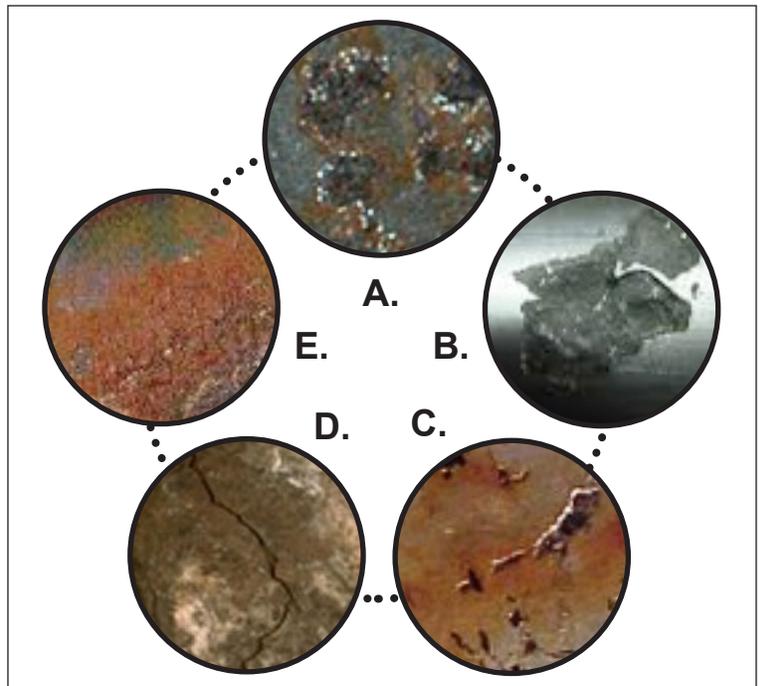


Figure C. Types of corrosion that can effect stainless steel if not treated properly.

- A. Pitting Corrosion** - a deep, narrow corrosive attack in a localized region which often causes rapid penetration of the substrate thickness.
- B. Crevice Corrosion** - a form of localized attack in which the site of the attack is an area where free access to the surrounding environment is restricted.
- C. Localized Galvanic Corrosion** - occurs locally only on some parts of the metal surface and it can be due to the matching of materials of a different nature.
- D. Stress Corrosion Cracking** - is the growth of crack formation in a corrosive environment.
- E. Microbiologically Influenced Corrosion** - also called bacterial corrosion, bio-corrosion, microbiologically influenced corrosion, or microbially induced corrosion, is corrosion caused or promoted by microorganisms.

Why Electropolish?

Purification:

Electropolishing restricts bacteria growth by removing hydrogen throughout the metal. Unlike a coating, an electropolished surface cannot flake off or chip. Electropolishing also removes free Iron which cause metals to rust. By removing the free Iron and adding the hard Chromium layer, electropolishing leaves behind corrosion resistant alloys.

Adhesion:

Electropolishing improves the adhesion of paint, adhesives or plasma. Oxides, oil, corrosion and organic debris on the metal surface make adhesion difficult. After electropolishing, the bonding ability during welding or soldering is improved greatly, do to the restriction of out gassing once impurities are removed.

Other Advantages:

Electropolishing is a great way to remove Hydrogen from stainless steel, which is important in counteracting metal fatigue due to Hydrogen embrittlement. This makes it difficult for bacteria to grow in an environment that is free from Hydrogen.