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ELECTROPOLISHING OF STAINLESS STEEL

Electropolishing can be used for both functional and decorative applications. For decorative, complex applications brightness can be achieved that is not possible to achieve by any other process. The obtained smooth, contaminant free and chromium-enriched surface gives optimal corrosion resistance also in critical applications, making the material less sensitive to contaminant attachment, and easy to clean. These facts distinguish electropolishing from other surface treatments for functional applications.

Applications

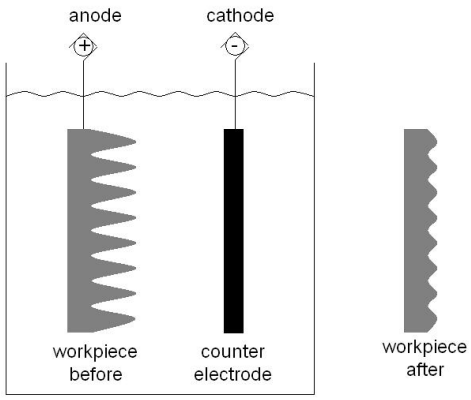
Major applications are found in food and pharmaceutical industries or clean room environments; items like vessels, reactors, wire goods such as autoclave trays, baskets, filtration and catering equipment, where supreme cleanliness is required. Electropolished stainless steels are considerably more non-stick than can be achieved by other methods. Greatly enhanced 'cleanability' ensures both reduced downtime in plant maintenance and a high degree of product purity.

Pre-treatment

Degreasing, Pickling and Passivating is used as a pre-treatment for electropolishing to remove oils and greases, weld scale and heat tint. Degreasing is necessary for uniform pickling and electropolishing. Weld scale and heat tint are removed with pickling prior to the electropolishing to ensure a uniform finish. Welded seams, hot rolled plate or any damage caused in fabrication are often polished mechanically prior to electropolishing. Moreover, mechanical polishing before electropolishing enables the lowest possible roughness to be achieved.

Electropolishing process

Electropolishing is commercially performed on stainless steels including duplex and hastelloy. In practice it is a process like electroplating except that it does not apply a coating but instead removes material from the surface. As with electroplating, electropolishing is usually performed by immersing the part in an electrolyte and applying a direct current. Electroplating is a cathodic process whereas electropolishing is anodic. The sample is connected with the anode (positive). The cathode (negative) consists of a suitable conductor. After immersion of the work piece and the cathode into the electrolyte (a conducting liquid), the electric circuit is closed and a direct current is applied. In order to electropolish geometrically complex parts, special counter electrodes (jigging) need to be designed.



Producing a smooth and bright finish

Because it is an electrolytic process, those areas closest to the cathode are removed faster than those further away. Thus deburring and smoothing occur as part of the process. A uniform, bright finish is produced, even in otherwise difficult-to-reach areas. The usual surface finish requirements for pharmaceutical industries is 0.25 – 0.6 microns Ra and the degree of improvement in surface smoothness is typically 30 to 50% at these levels. The smoothness gives the surface lower adhesion properties, effectively leading to reduced dirt attachment and a surface which is easy to clean.

Removing embedded contamination in the process

With electropolishing the surface becomes contaminant free, because surface material can only be removed by dissolution. Electropolishing removes approximately 30/40 microns including all kinds of embedded surface contamination, producing an extremely clean, uniform and homogenous surface. The obtained smoothness and homogeneous surface are also beneficial for low friction applications.

A dense chromium-rich passive layer

In addition some chromium enrichment is found since chrome dissolves more slowly in the electrolyte than iron or nickel. The chromium enrichment in the surface layer gives electropolished parts enhanced corrosion resistance. The resulting chromium oxide layer is very dense and entirely homogenous since complete removal of deeply embedded contamination has taken place. The effect is that an exceptionally clean surface is found with corrosion resistance unmatched by any other process.

The advantages

- ► Reduction of surface roughness (circa 50 % in Ra)
- ► Removal of sharp edges (burrs, corners), sometimes referred to as chemical milling
- ► Results in a bright, reflecting surface and cosmetically desirable product with increased light reflection
- ► Improved resistance to corrosion due to chromium enrichment of the surface
- ► Reduced dirt adhesion
- ► Reduced friction
- ► Easier to clean

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