



Dealer Directory - Confidential Case Histories

- ▶ Home
- ▶ About Us
- ▶ Parts Washing
- ▶ Dynamic Flow Combination
- ▶ Products & Systems
- ▶ Dealer Directory
- ▶ Confidential Case Histories
- ▶ Sample Proposals
- ▶ Specification Sheets
- ▶ Drawings
- ▶ Manuals
- ▶ Video Clips

Citric Acid Passivation



Stainless steel derives its corrosion resistant properties from its chromium content. The chromium, in the presence of air, especially oxygen, forms a thin, hard adherent film of chromium oxide on the surface of the alloy. It is this chromic oxide layer that is inert (passive) to the surrounding environment and gives stainless steel its corrosion resistant properties.

Passivation is "the removal of exogenous iron or iron compounds from the surface of stainless steel by means of a chemical dissolution, most typically by a treatment with an acid solution that will remove the surface contamination, but will not significantly affect the stainless steel itself." ASTM A380 also describes passivation as "the chemical treatment of stainless steel with a mild oxidant, such as a nitric acid solution, for the purpose of enhancing the spontaneous formation of the protective passive film."

Simply stated, utilizing a mild oxidant, such as a mineral or organic acid solution, to promote the removal of excess iron from the surface of the stainless steel will enhance the formation of a chromic oxide layer thereby enhancing its corrosion resistant properties.

Typically, passivation is performed with a nitric acid bath from 20 to 50% by volume. Temperatures range from ambient to 160 degrees F. Immersion times can be as long as two hours and even include the addition of a chromate salt. Nitric acid is by far the most accepted means by which passivation is performed. Recently, however, there has been an increase in the amount of industries that have successfully implemented citric acid into their passivation procedures.

Citric acid is an organic acid unlike nitric which is a mineral acid. It reacts with the iron much better than nitric and does not attack elements in stainless steel alloy which nitric acid does. And citric acid, overall, is a less harmful chemical than nitric acid. Nitric acid raises problems with environmental disposal, health and safety, environmental pollution, increased environmental liability and regulation, and overall complexity to utilize it. Citric acid on the other hand is derived from oranges, utilized in food and beverage products, is acceptable in some instances to go right to drain, depending upon contaminants and local environmental regulations, and much more friendlier when it comes to worker health and safety.

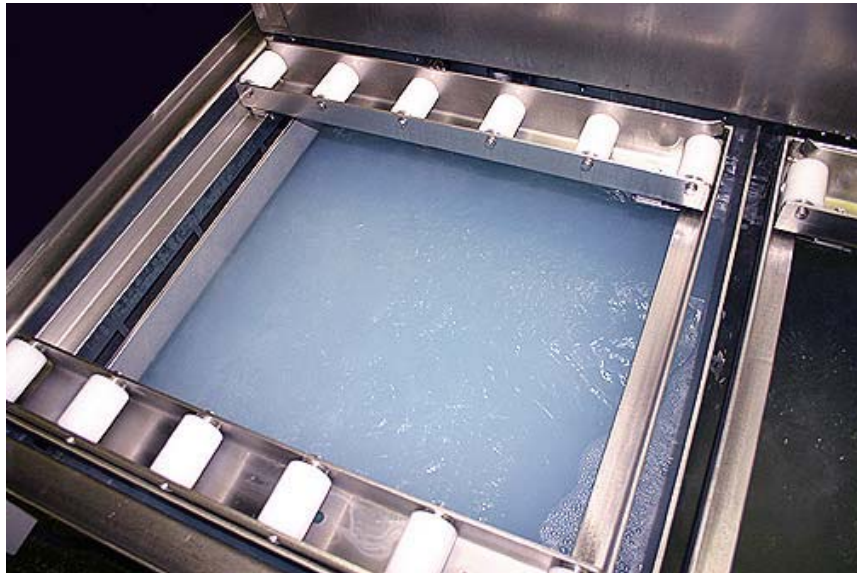
Even the process aspect of citric acid passivation is easier. Stainless steel must be cleaned prior to any passivation procedure. All surfaces contaminated with oil, grease, chips, grinding dust, lapping compound, buffing compound, coolant, and/or swarf must be removed.

The following Case History is of a Citric Acid Passivation System for precision medical components. The system consists of five stages comprising two [RAMCO MKD/T Consoles](#).

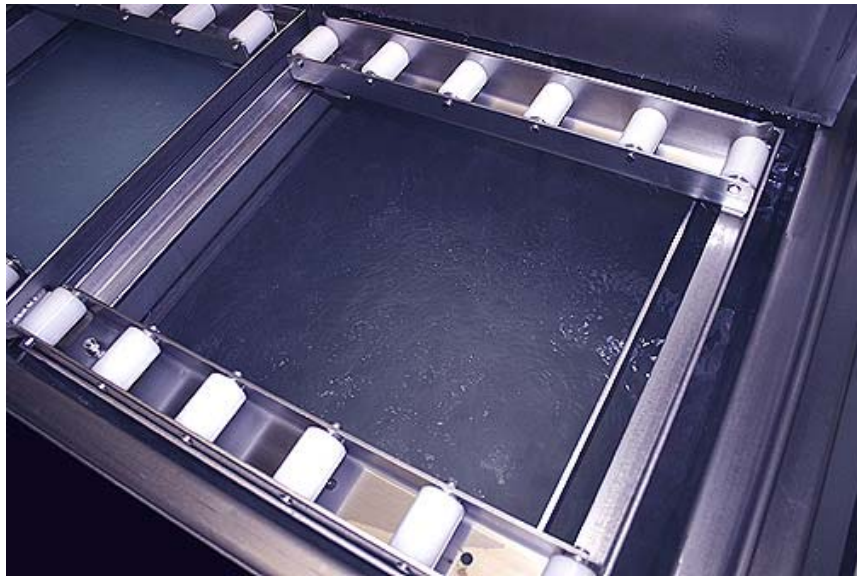
THE PROCESS:



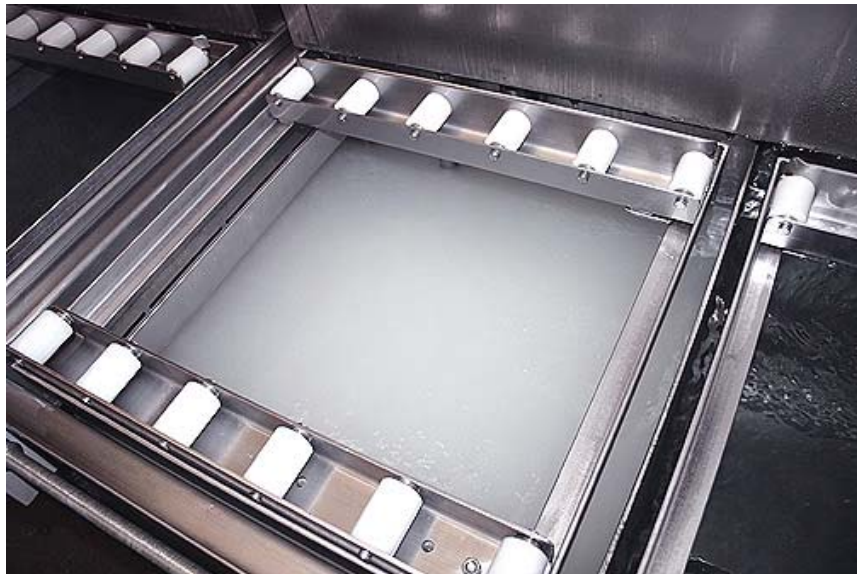
PRECISION WASH - The parts are batch loaded into 18"L x 18"W x 6"H stainless steel baskets and placed on the first transport elevator in **Stage One**. Using a 2% solution of a mild alkaline detergent at 150 degrees F the parts are precision washed using Turbo/Filtration, vertical agitation and sweep frequency ultrasonics. The unique RAMCO ultrasonic system cascades powerful sweep frequency (between 38 to 42 kHz) ultrasonics with our standard turbo/filter/agitation washing. Using mechanical agitation washing to remove gross contamination and ultrasonic cleaning to remove finer and/or more resistive deposits is a very effective processing routine. The steps are sequenced with dual digital cascading timers for agitation washing and ultrasonic cleaning.



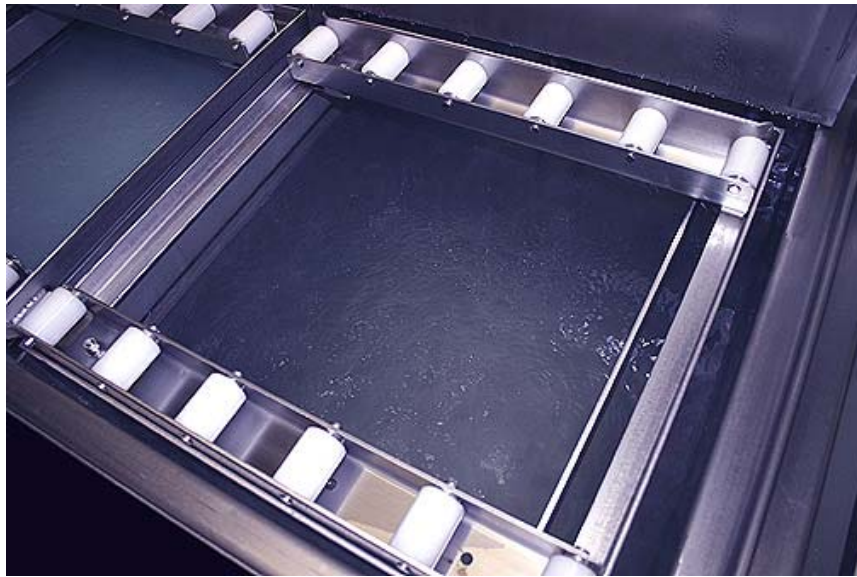
PRECISION RINSE - The basket is laterally transferred over special platform roller conveyor sections onto **Stage Two**. Using DI water at 150 degrees F the parts are precision rinsed using vertical agitation and sweep frequency ultrasonics.



PASSIVATION USING ULTRASONICS - The basket is laterally transferred over special platform roller conveyor sections on to **Stage Three**. Using a 4% solution of citric acid at 150 degrees F the parts are passivated using Turbo/Filtration, vertical agitation and sweep frequency ultrasonics. The use of ultrasonics in the passivation bath speeds up the process and ensures uniform passivation by bringing the citric acid solution into contact with all areas of the substrate down to the finest microscopic surfaces.



PRECISION RINSE - The basket of parts is then laterally transferred over platform roller conveyor to **Stage Four**. Using DI water at 150 degrees F the parts are precision rinsed using vertical agitation and sweep frequency ultrasonics.



HOT AIR BLOWOFF DRYING - The basket of parts is then laterally transferred over platform roller conveyor to **Stage Five**. Using hot air at 180 degrees F the parts are dried. RAMCO [Hot Air Knife Blow-Off Dryers](#) get [maximum evaporation providing rapid drying without excessive heat.](#)



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