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Technical Data Sheet • CHEMEON® Electropolish 1000

Description:

Will smooth, brighten and to some extent deburr Aluminum alloys simultaneously. Can attain true mirror-bright finishes. Operation and maintenance is virtually problem free. Non-toxic, non-flammable and non-explosive. Completely soluble in water and good prep for the subsequent conversion coatings. Does not affect the polished aluminum and produces low electrical surfaces on the aluminum alloys. Has relatively broad current density and operating temperatures. Minimal effluent treatment and contains no chromium compounds or halogens. Finish gives the maximum reflectivity and color.

Use Directions:

CHEMEON Electropolish 1000 is used at 100% by volume.

Finishes and Surface Conditions:

For uniform results parts must be clean prior to electropolishing. Solvent cleaning, vapor degreasing, soak tank or electrolytic cleaning are all-satisfactory. Grease, oil or soil, if not removed, will form a film or scum on the surface of the electropolishing solution. This must be skimmed off to prevent it's adhering to parts going in or out of the tank.

Finishes from satin to mirror-bright are accomplished by controlling time, temperature or both. A low temperature and/or short immersion time will produce finishes in the satin range. Bright finishes are accomplished by increasing time and/or temperature. Higher temperatures and current densities decrease time necessary to product bright finishes, as well as deburring and stock removal for size control.

Metals having a fine grain are important for best electropolishing results. Also, surfaces should be free of metallic seams, inclusions and directional roll marks. Articles requiring a chrome-like finish are sometimes pre-polishes before electropolishing.

When surfaces are porous, as a result of mill finish, pickling or have an "orange peel" appearance, preliminary treatment may be required to produce smooth, bright surfaces. Nicks and scratches, deeper than the amount of material removed by electropolishing, will still be apparent. Pre-treatments may be accomplished by wheel polishing, tumbling, belt sanding, shot penning or blasting. Also, acid or alkaline etching will eliminate many surface blemishes and imperfections but reduces the possibility of true mirror finishes. These treatments, used in conjunction with electropolishing, may also be used to produce very appealing and unusual finishes.

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CHEMEON Electropolish 1000 Solution Maintenance:

When the CHEMEON Electropolish 1000 solution has been used sufficiently to be "broken in" there will be a noticeable improvement in "throwing power", as well as a decrease in bubble size at the anode and cathode. After the solution has been "broken in" the specific gravity should be maintained in the range of from 1.500 to 1.600. Specific gravity indicates total content of metal salts, electrolyte and water.

To maintain optimum performance of the CHEMEON Electropolish 1000 solution the three controlling factors are: concentration of CHEMEON Electropolish 1000, metal salt content and water content. The metal salt content is found by measuring the volume of precipitate in a neutralized sample of the electrolyte. An estimation of the water content can be made from the specific gravity and metal content factors, thermal approximation method or more precisely by the Karl Fischer titration methods. Please see ANALYSIS AND CONTROL.
Solution loss, due to drag-out or sludge removal, is to be replenished by adding CHEMEON Electropolish 1000 concentrate.

Since the CHEMEON Electropolish 1000 solution is semi-sludging (most of the metallic salts formed as a product of electropolishing will settle to the bottom of the tank). It will be necessary, from time to time to remove the sludge. This is one of the factors contributing to the long life of the solution. Non- sludging baths have a finite life determined by the percentage of metallic salts in solution.

Parts not completely free of grease and oil will cause a film or scum to float on the solution. This should be skimmed off, since when unfinished parts are introduced into the solution they may pick up the scum and cause an uneven polished appearance.

After prolonged operation, the CHEMEON Electropolish 1000 solution is maintained in balance (other than additions required to replace solution loss due to drag-out and sludge removal) by the addition of one or combinations of the following: CHEMEON Electropolish 1000 concentrate, or water. This is determined by the operator's experience, a strip test, or by chemical analysis.

During electropolishing the aluminum metal is converted to aluminum phosphate. Some aluminum phosphate in the solution is beneficial. Ordinarily, drag-out is sufficient to create an "equilibrium" condition, due to new solution being added. Dropped parts from the racks (not removed) will dissolve, thus increasing the aluminum phosphate content; also, electropolishing pieces for an excessively long time, at higher current densities, can upset this "equilibrium."
A slush ice in the solution, sometimes near the top, is indicative of excessive aluminum phosphate. This condition is aggravated by low water content in the solution. When this occurs

it may be necessary to remove a portion of the solution from the tank and add sufficient new solution to bring the aluminum phosphate content back into the normal range. This may be determined by referring to the section on ANALYSIS AND CONTROL.
The water content in the CHEMEON Electropolish 1000 solution is important. In original make-up sufficient water is present. After operating for some time some water may need to be added. Alternately excessive water may be carried in on the parts from the previous rinsing operation.

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Excessive water drag- in produces etching and loss of brightness, while insufficient water content reduces solution conductivity, hence, a loss of current density and a longer polishing time is required.

Electropolishing Technique

The part to be electropolished is made positive and the cathode negative - the reverse of electroplating. Low voltage direct current is supplied ordinarily in the range from 6 to 9 volts, seldom exceeding 12 volts. Current density ranges from 40 to 80 amperes per square foot (4.3 A/dm^2 to 8.16 A/dm^2)

To decrease electropolishing time, voltage is increased (usually necessitating agitation.) Voltage is also increased when anode to cathode distance is great. The operating temperature range for the CHEMEON Electropolish 1000 electropolishing solution is from 100 to 175 ºF (37 to 80 ºC). The preferred range being between 120-130 ºF (48 to 53 ºC). A low temperature will produce a satin or semi-bright finish. High temperatures allow higher current densities, thus a brighter finish in less time.

Regular straight lead tank cathodes are used but may not be adequate for some irregular or shaped parts or when polishing is required on internal surfaces. When conforming shaped cathodes are necessary construction is generally of chemical sheet lead, similar in practice as chromium plating. A metal tank lining should not be used as a cathode or damage will occur. Should a metal-lined tank be used with tank cathodes, precaution should be taken to insure that the combined distance between the back side of the cathode to the tank wall and between the piece part and bottom, side or end of the tank is substantially more than the distance from the piece part to the cathode. To prevent tank damage insert panels of fiberglass, polyethylene or polypropylene along tank walls or bottom.

Racks are preferably constructed of aluminum or titanium (as used in bright dipping and anodizing). The current density for electropolishing is considerably higher than in anodizing; therefore, sufficient cross sectional area must be provided. Copper or other alloys may also be used, but copper contamination of the solution will cause an immersion deposit on the aluminum during transfer, unless coated. Parts are racked, hung on hooks, clamped or held by fingers to insure good electrical contact.

Lightweight parts must have a firm contact to prevent arcing. The work is made positive (anodic). The parts to be electropolished are positioned in such a manner as to allow the greatest area to be exposed parallel to the cathodes. Parts also must be oriented to prevent gas pockets. Exposed portions of racks and tips (except titanium) are subject to electrochemical attack and gradually diminish in thickness. Dipping the tips in molten solder periodically to build up size may increase the useful life of the rack. Other exposed parts of the rack not contacting the part to be polished, should be insulated with rack coating or masking materials such as used on plating racks.

Agitation is beneficial during electropolishing and can be provided by solution agitation, air agitation or work-rod agitation. The latter method is preferred. If solution agitation is employed,

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insure complete and uniform agitation. The same is true with air agitation, being sure that the air does not disturb the sludge build-up in the tank bottom. Good agitation can eliminate gas streaks, pockets and burning and allow higher current densities to be used, thus decreasing the time required to electropolish to the desired finish. When agitation is used be sure parts are racked securely.

A decrease in current density may be noticed shortly after current is applied during electropolishing. This is due to polarization and film formation and is reduced by proper agitation. While most emphasis is give to the anode reactions the cathode reaction cannot be neglected. Basic metal salts are precipitated on the cathode by hydrogen reduction to restrain the increase of metal content in the electrolyte. The ratio of the cathode to anode area is critical and should exceed the anode area of at least 2 to 1 and preferably 3 or 4 to 1, if possible.
The basic salts precipitated on the cathodes should be removed regularly. To reduce resistance and maintain a uniform current flow they are soaked in water several hours or over night and brushed clean before returning to the tank.

Operating Sequence
Cleaning: As in any electro-chemical operation, best results cannot be obtained with improper cleaning. Vapor degreasing, solvent cleaning, soak-tank and electrolytic cleaning all work well. Care must be taken when strong uninhibited caustic-type cleaners are used, to be certain of thorough rinsing, since these can attack and etch aluminum, as well as tend to neutralize the acidity of the electropolishing bath.
Electropolishing: Prior to electropolishing, all parts must be rinsed in water to eliminate any carry-over from cleaner tank, unless solvent cleaning or vapor degreasing was used. Electropolishing carried on in suggested manner under the heading ELECTROPOLISHING

TECHNIQUE, as mentioned on preceding pages. The following rinsing steps, after electropolishing, are usually adequate; more rinses may be necessary in special cases. Should rinsing be difficult or slow, consider agitation, such as air.

First Water Rinse: Parts are rinsed by immersion or spray to remove the electropolishing solution from the part. Ordinarily ambient temperature water is better than cold, since the solution will rinse faster. Depending upon the operating temperature of the electropolishing solution, transfer to the first water rinse should be prompt, to prevent chemical attack on the aluminum surface while in the air. Good rinsing at this stage will extend the life of the following rinse. Either running water or periodic emptying of this is important.

Acid and Water Rinse: This stage is especially useful in preventing a milky or cloudy film from appearing on the finished piece, as well as eliminating the dark smut which may possibly appear due to the copper in the alloy or being present in the solution. This solution is made from 20% to 35% nitric acid (by volume) and the balance water. it is used at ambient temperature. This rinse is changed only when it becomes ineffective.

Final Water Rinse: This rinse is usually operated hot, to dry the work rapidly, as well as rinsing off traces of nitric acid from the previous cycle. This rinse should also be changed

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frequently

Several compounds may be added to aid the appearance, eliminate water spotting and the drying of the finished piece. These are known generally as wetting agents, sequestering agents and chelating agents. Since each of these compounds acts in different ways, it would be best to determine, by experimentation or by writing us, as to which would be best for your needs.

Equipment

DC Power Source: Supplied either by rectifiers or low voltage motor generator sets – the same type of equipment as for plating. In either case, voltage control is recommended.

Cathodes: Usually made of chemical lead. Also, 300 series stainless steel is suitable.

Source of Heat: Steam through lead coils, carbate, tantalum or type 316 stainless steel pipe or plate type coils. Electric immersion heaters, quartz, Carpenter "20" or Hastelloy "C".

Electropolishing Tank: Usually constructed of lead-lined PVC or Koroseal lined steel tanks. Also, polyethylene, polypropylene, fiberglass linings or type 316 stainless steel are satisfactory. On PVC or Koroseal check temperature resistance.

First Water Rinse: Can be made of 300 series stainless steel, rubber lined or lead lined steel, ceramic ware, fiberglass, PVC, Koroseal, polyethylene or polypropylene.

Acid and Water Rinse Tank: Can be made of 300 series stainless steel, PVC or Koroseal line steel, ceramic ware, fiberglass, polyethylene or polypropylene.

Final Rinse Tank: Same as first water rinse, but if hot should be made of 300 series stainless steel, fiberglass, polyethylene, polypropylene or ceramic ware.
Note: For small laboratory type installations, Pyrex glassware is suitable for all of the above, including the electropolishing container.

Analysis and Control: Due to the stability and long life of the CHEMEON Electropolish 1000 solution, frequent analysis is usually unnecessary, other than maintaining proper specific gravity.