

Chrome Etch Bath Recovery by Vacuum Evaporation

General

Among the more valuable of non-precious metal solutions used in the electroplating industry are the chromic acid baths used for etching plastics prior to plating. With costs running as high as \$10 per gallon, it is economically very attractive to recover and reuse this solution.

QVF Vacuum Evaporators are now being used by numerous plastic platers to recover chrome etch, proof that this difficult-to-handle solution can be successfully and economically recovered.

Chrome etch solutions generally fall into two categories: the high-chrome etch (8-10 lbs./gal. of chromic acid only) and the chrome-sulfuric etch (3-5 lbs./gal. chromic acid and 20-40% sulfuric acid). Both of these solutions can be easily recovered with the QVF Vacuum Evaporator, and both can be handled by the same evaporator (though not simultaneously).

Therefore, if you are anticipating a change from one etch solution to the other, you need not be concerned about replacing or modifying the evaporator.

Operating Conditions

The QVF Chrome Etch Bath Recovery Evaporator is constructed of borosilicate glass, PTFE, and refractory metal, all fully compatible with chrome-etch solutions.

The operating temperature of a typical evaporator is 180-190 °F (82-88 °C) at a vacuum of 1 O-I 2" (254-305 mm) Hg.

Water distillate is produced that has less than 10 ppm of hexavalent chromium.

Because the concentrate will leave the evaporator at a temperature in the range of 180-190 °F, it may be necessary to provide a small tank to hold the recovered etch concentrate while allowing it to cool before returning it to the plating tank.

Purification

The most serious contaminant encountered in chrome etch solutions is trivalent chromium. The plastic etching process results in the reduction of the hexavalent chromium to trivalent chromium. Some trivalent chromium is necessary to achieve good etching, but excessive amounts will adversely affect the etching process, as well as make rinsing more difficult.

Methods currently available for removing trivalent chromium are as follows:

.Electra-oxidation

This process, also known as "dummying," is well known to most electroplaters and is widely used as a means of removing contaminants in many plating solutions.

By the use of high cathode-current density and low anode-current density, the trivalent chromium is effectively re-oxidized to hexavalent chromium. Optimum cell design is best determined by some experimentation with a given solution, since requirements will vary with different solution composition.

A practical starting point would be an anode-to-cathode area ratio of 30:1, with an anode current density of 20 ASF and a cathode current density of 600 ASF. Anode material is lead, and cathode material is nickel. Operating temperature should be in the 150 °F (65 °C) range, and cell voltage approximately 4.5.

This purification method has several advantages that make it quite attractive. It is relatively efficient as long as very low levels of trivalent chrome are not necessary (below 5 g/l). There are no waste byproducts that must be disposed of or treated. And, lastly, capital expenditure is relatively low.

The main disadvantage with this approach is that the equipment must be designed and specified by the user. Recently, several tri-chrome oxidizing devices have been commercialized, which may prove to be effective.

. *Electrodialysis*

This is a fairly recent development. It can best be described as an "electrolytic filter." The trivalent chromium is separated from the hexavalent chromium across a ceramic membrane in a charged field.

The main disadvantage of this technique is that the trivalent chromium is only removed — it is not re-oxidized to hexavalent chromium. Therefore, treatment and disposal are required.

An advantage is that the equipment is available as a pre-assembled unit.

. *Ion Exchange*

Historically, ion exchange has not been an effective tool for trivalent chrome removal because of the difficulty of maintaining resin life in high chromic-acid concentrations. In addition, it has not been effective for chrome-sulfuric etch solutions.

Recent developments indicate that ion exchange, or decationization, is a viable technique for trivalent removal.

Advantages and disadvantages are essentially the same as those for electrodialysis. Additionally, more waste is produced and must be treated, as well as a requirement for considerable bulk storage for regenerating chemicals. Also, the decationizing resins are quite expensive.

Concentration Limits

Because of the relatively low water evaporation rate from most chrome etch baths, recovered etchant must be concentrated to a relatively high level in order to return it to the etch tank. The QVF Vacuum Evaporator can recover a wide range of concentrations and can be finely adjusted to deliver the concentration required for a specific situation.

However, please note that, as etch concentration increases, the heat transfer coefficient of the solution decreases, and both the boiling point and the viscosity increase. The result is that the water evaporation rate and the evaporator capacity decrease as the concentration of recovered etchant increases.

For this reason, QVF Vacuum Evaporators designated for etch recovery are especially equipped to compensate for the reduced water-evaporation rate and can produce concentrations of recovered chrome acid etch baths as high as 9 lbs./gal. of chromic acid.

Other Technical Information Sheets Available

TI-CN

 Cyanide Plating Bath Recovery by Vacuum Evaporation

TI-CR

 Chrome Plating Bath Recovery by Vacuum Evaporation

TI-NI

 Nickel Plating Bath Recovery by Vacuum Evaporation

TI-RP

 Electroplating Rinse Practice and Evaporator Sizing

TI-CRE: This Technical Information Sheet supersedes all previous issues.

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