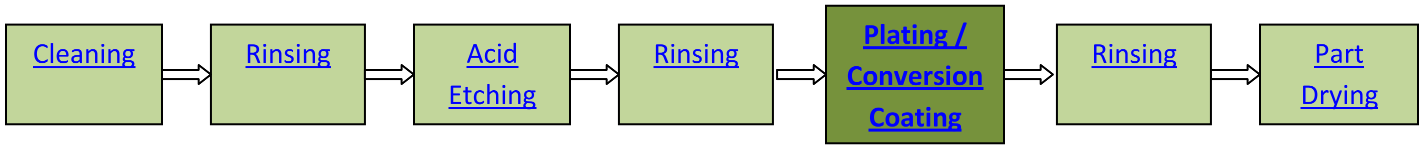
Plating or Conversion Coatings



Overview of plating or conversion coating

Plating is the application of a metal or metals to a substrate, the typical substrate being metal. A typical line will be dedicated to a specific base metal and a specific plating. For instance, a plating line may be designed to plate steel parts with a layer of copper followed by chrome. Since plating is being applied to the part, the part dimensions will change in a direct relationship to the amount of plating applied.

Plating can be applied either with or without the use of electrical current. For example there is nickel plating which requires electric current to force the nickel to plate out on the parts and there is electroless nickel plating which will plate out spontaneously but slowly without the application of an electric current.

The conversion coating process is a coating created on the surface of a metal part due to the reaction of the metal surface with a chemical. Examples of conversion coatings are phosphate, chromate, black oxide, and iridite on aluminum. A special type of conversion coating is anodizing and will be discussed later. A part that has a conversion coating will have dimensional growth that is proportional to the conversion coating thickness but is not a direct relationship as in plating. This is because the conversion coating is consuming some of the substrate metal in the process of forming the coating. A conversion coating is growing into the part as it is formed but is also of greater volume than the original metal. Therefore it both grows into the part and expands as the coating forms.

Typical steps associated with both plating and conversion coating:

1. Cleaning (typically an alkaline chemistry)
2. Rinsing
3. Acid etching, acid cleaning

4. Rinsing
5. Plating or Conversion Coating
6. Rinsing
7. Part Drying

Example of an automatic hoist plating line

http://www.bakertech.com/rack.htm

Example of Black Oxide conversion coating on steel

Solution Recovery:

The method of either extending the life of a plating solution will be very dependent on the type of plating being done. The following is an overview of the technologies available to recovery or control various plating solutions.

Chrome plating:

There are three recovery areas from a chromium plating process tank.

1. Exhaust system
   Mesh Pad Mist Eliminators in the ventilation system provide two advantages. First, they are very effective as the first stage in chrome mist removal. Second the back wash operation for the mesh pads allows the chromic acid to be recovered and returned to the plating tank.
2. Rinse tank

Since a chrome plating tank is typically heated and therefore losing volume due to evaporation, a stagnant primary rinse tank should be used for make-up solution to the chrome tank. In addition, a porous pot described below, can concentrate the chromic acid in a rinse tank for recovery.

3. Plating tank
   Ceramic porous pots are one commercially available method of keeping the non-chromium metal contaminants to a minimum. The technology is the use of a ceramic “pot” as a membrane and the use of electrodes to pull the non-chromium metal ions into the pot while leaving the chromic acid ions in the tank. The pot is suspended in the chrome tank with its own rectifier to provide continuous filtration of the metal contaminants. One source of the porous pot equipment is Hard Chrome Plating Consultants, Inc.

Methods of plating solution recovery from rinses:

The goal in solution recovery is to put the recovered solution back into the plating tank in a form that will not negatively influence the plating or conversion coating tank chemistry.

Direct evaporative loss additions

The simplest method is to have a stagnant rinse tank for the first rinse and use this rinse water as make-up water in the process tank. This is particularly useful for hot process tanks since the process tank is regular need of water to compensate for evaporation. In the case of lower temperature process tanks with minimal evaporation, the rinse water containing process chemistry will need to be concentrated before being added back to the process tank. This can be accomplished off line with an evaporative system to concentrate the rinse water to the correct process concentration. Then the concentrate can be used as chemical make-up solution in the process tank.

One warning regarding introduction of process chemistry from rinse water is in the scenario where the dragout from the process tank to the rinse tank serves the purpose of removing process tank impurities. In this situation, the reuse of the recovered chemistry will shorten the process bath life by reintroducing the impurities. The aluminum anodizing process is an example where the dragout losses from the anodizing tank include dissolved aluminum which tends to build up in the tank and needs to be removed anyway.

Ion Exchange

The purpose of ion exchange is to capture and concentrate the dissolved metals in a plating solution rinse. Once captured by the ion exchange resin, the metal can be removed during the regeneration process, concentrated by evaporation and returned to the plating tank. Again, there are potentially other chemicals in the plating bath which are not captured by the ion exchange (organics such as saccharin) and therefore need to be added to the plating bath to maintain the proper concentrations.

If the ion exchange regeneration solution cannot be used for plating tank additions, it may have high value for its metal content. Some companies such as Inmetco are very interested in metal recovery due to the value of the metal. Copper ($3.81/lb), nickel ($10.21/lb), and chrome ($5.81/lb) all have relatively high market value (2010) and therefore are worth considering for scrap recovery.

Electrodialysis

Electrodialysis is very similar to diffusion dialysis in that there is a semi-permeable membrane that allows preferential passage of some ions while excluding others. The process of moving ions selectively across the membrane is accelerated by the use of electrodes beyond the membranes to help draw the ions through the membranes. This technology is typically used in nickel and electroless nickel plating to recover the nickel chemistry from the primary rinse tanks.

Reverse Osmosis

Reverse osmosis is typically used to concentrate the desired chemicals from a dilute solution. The process involves a membrane that is permeable to water and small ions such as sodium or potassium but not larger ions. Pressure is applied to the solution to force water through the membrane and leaving behind the chemicals of value. Plating solutions of high value can be concentrated from rinse solutions and recovered for reuse using this method. Plating solutions such as lkjlkjlkj can be recovered in this way.

Metal recovery from rinses

Electrowinning

Concentrated rinses can be sent to an electrowinning (electroplating) tank to plate out the metal which can then be sent out as scrap metal rather than being treated by other means. The wastewater from the electrowinning process will still need to be treated for metal but the metal content will be much lower and therefore cost less to treat and cost less for sludge disposal since the sludge volume will be much reduced.

Electrowinning is very common in precious metal plating since the electrowinning system can be installed directly in the rinse tanks and therefore keeps the precious metal concentrations very low in the final rinses by keeping the concentrations low in the primary rinses. As a final precious metal recovery step, the final rinse can also be recirculated through an ion exchange system to scavenge the remaining precious metal in the final flowing rinse before the rinse goes to wastewater treatment.