# FILTRATION AND PURIFICATION OF PCB SOLUTIONS

*Electrolytic and electroless plating solutions as well as photoresists, etc. all require solids or organic impurity removal, not only to attain, but to maintain high quality PCB production. Consequently, the need for greater cleanliness has brought about rapid advancements in the field of filtration and purification of plating solutions. This paper describes current approaches to these problems.*

The electronics industry uses many liquids in the various processes required to manufacture printed boards. "Good" water is essential since it is used to make up most of the solutions and for rinsing and cooling. Various water treatments may be required, including softening, deionizing, and/or purifying with carbon, all of which may utilize prefiltration for solids removal to prevent surface loading of the resin or carbon. This may be followed by several stages of trap filtration down to, and including, sub-micron sizes if absolute clarity is required.

One solution requiring continuous filtration is photoresist. It is essential to have this solution free of contaminants otherwise, during conveyorized developing, small particles of the dry film resist are codeposited on the copper laminate, thus leaving a light impervious barrier. This speck leaves a spot of unexposed photoresist on the circuit pattern. Since the ultraviolet rays are unable to penetrate the particle of dirt, the resist does not completely harden. The result is a small area of exposed copper, which after etching, produces a small pinhole on the circuitry or a nodule in the land area of the printed circuit board. In either case, this would result in a sub-standard product or even a complete reject.

Finally, all of the electroplating solutions such as copper, tin, tin-nickel, nickel and the precious metal baths such as gold and rhodium, plus all of the electroless plating solutions such as nickel and copper, require filtration for removal of solids. Some require removal of organic impurities with activated carbon, which is a purification process sometimes handled with filtration equipment.

The need for filtration and purification of plating baths cannot be emphasized enough in the manufacturing of printed circuits. This is especially true where copper is used for through hole plating in order to achieve continuity through each hole, making it easy to solder and assemble the components. Any void in the plating in the hole caused by small particles of contaminants causes a reduction in the area available to carry the electric current. A complete void would, of course, have no contact with the hole at all. Rejects would also result when tin or tin-nickel are used as resists in the etching process, since any voids would allow etching in unwanted areas. Nickel, gold, or rhodium plating baths are just as critical, depending on the requirement of the finished product. Contaminants in any of these solutions would result in a rough deposit on the conductor pattern or connector tabs on the PCB.

If activated carbon powder is used to adsorb organic impurities, it may be added to a pre-coated surface or mixed with the solution in a treatment tank. Adsorption is quick, but the powdered carbon is messy to remove from the solution. Granular carbon is generally preferred and is held in a separate chamber for removal of organic impurities. Prefiltration to remove solids will increase the surface adsorption efficiency of the porous carbon granules. Maximum ductility can be achieved by filtering the acid copper solution through granular carbon.

Perhaps the most critical plating is carried out on memory discs or drums which, like the plating of phonograph record masters, requires the ultimate in freedom from solids in the solution. This can only be accomplished by using filter media dense enough to remove the undesirable particles at substantial flow rates to have all the liquid pass through the filter at sufficiently frequent intervals so that they will be picked up. The filter must also have sufficient solids holding capacity to maintain a high flow rate.

Flow rate is the only means of carrying solids to a filter or bringing fresh solution into contact with the carbon. The rate of flow is referred to as turnover, i.e., total gallons pumped per hour in relation to the size of the tank. For example, 200 gph on a 100 gallon tank is two turnovers per hour. Dirt holding capacity

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is essential and can be attained with disposable paper, or cartridges of different porosities, or filter surfaces coated with filter aid. Porosities of 100 micron down to less than 1 micron are typical.

In practice, the average plating solution is turned over twice per hour. Current recommendations are at least four tank turnovers per hour; however, to achieve the ultimate in clarity, turnovers of up to ten times per hour may be necessary. Bearing in mind that the initial flow rate is not the average flow rate, an initial turnover of 1,000 gph may fall to 200 gph prior to cleaning the filter, so that the actual average flow would probably be about 600 gph. Depending upon the type of filter media used this is just over once per hour on a 500 gallon tank. The most common type of filter media used in the electronics industry is a depth-type cartridge which is available in different porosities to achieve the desired particle retention, from 100 micron down to 1/2 micron on a nominal basis. These cartridges are wound from various synthetic fibers such as polypropylene to achieve the desired compatibility with the chemicals in the solution.

Important specifications which must be considered before purchasing a filtration or purification system are as follows:

1. What degree of clarity is necessary to achieve the quality of plating required? High - average - low?
2. Quantity of liquid (total quantity of plating solution).
3. Impurities to be removed:
   Solids - size and type (slimy, gritty) + organics.
   Continuous filtration and carbon treatment required?
4. Flow rate: Tank turnovers/hour
5. Continuous or batch carbon treatment.
6. Pump specification: *In-tank or out-of-tank*.
7. Filter media and porosity

Other considerations are the materials of construction, which must be compatible with the solutions and the positioning of the filtration system. The amount of solids or organics present will determine the size of the filter chamber itself, which must provide a sufficient amount of dirt holding capacity, and whether or not carbon is to be used as part of the filter process or as a separate function in another chamber. All, of course, must be assembled into a compatible, functional piece of equipment, fitting into the usual limited amount of space available.

Finally, the best type of pump capable of delivering the flow and pressure as previously explained, must be chosen. Centrifugal pumps of all-plastic construction are quite popular for use on the tanks. Mechanical type seals are available, but pumps without any seals using magnetic coupling have now become popular. Leakage is prevented because the pump does not have any opening for the shaft to pass through which would require a seal. Vertical cantilever in-tank pumps are also available which allow the unit to be submerged in the liquid. This is an extremely desirable feature for use on precious metal solutions to eliminate any liquid loss.

Sump type pumps are also available in metal or plastic construction. They generally are free of seals, per se, but use the liquid they are submerged in as a seal. They can be used on virtually any solution as long as there is room in the tank or reservoir. They are also used for the transfer of liquids used in the waste treatment system or any other recirculatory rinse or spray tanks. On certain solutions, they can also be used for air-free eductor agitation without filtration.

Each of these components is now assembled into a functional package. Valves may be added to control or direct flow. A chamber for priming of the pump, or to be used for mixing slurries to pre-coat the filter, may also be added. A pressure gauge to indicate condition of the filter is also desirable. And last, but not least, a suitable space should be found to place the unit where it can be conveniently serviced.

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