# Is Tradition Costing You Customers and Higher Rejects?

*by*
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Major advances in the way plating solutions can be filtered, purified and agitated will be reviewed. Special attention will be given to cartridge filtration systems, advanced methods of solution purification and pumped eductor agitation systems.

An overview of automatic filtration systems, enhanced by pumped eductor agitation, including details on sizing appropriate systems and a review of various case histories, together with a comparison between batch and continuous granular carbon purification will make the case for breaking with tradition in order to reduce operating costs, improve process control and reduce rejects.

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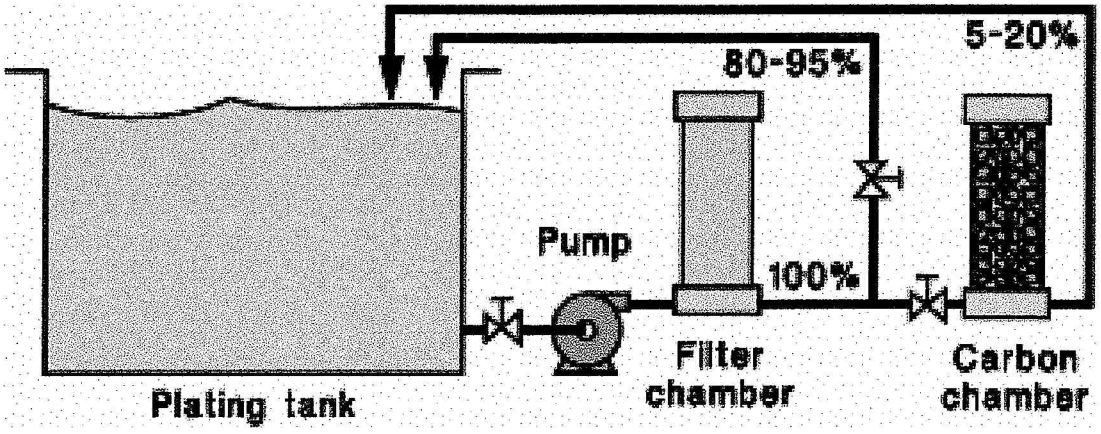
Traditions are often presumed to be unalterable, and deeply important. There are family traditions - the special things that are created within each family to fit their lifestyle. They are also the everyday routines we follow, such as the time we get up, the foods we have for breakfast, the things we do on the weekends, etc. *W. Somerset Maugham* said, "Tradition is a guide and not a jailer". With these words in mind, we will review some new techniques for filtration, purification and agitation that will help reduce cost, environmental problems, rejects, re-work and improve profitability.

## ACTIVATED CARBON PURIFICATION

Virtually all plating solutions will require purification through the adsorption of impurities by activated carbon. Solutions containing wetting agents and brighteners require the most use of carbon. When oil is transferred into the bath, it is dispersed throughout the solution and clings to the parts, causing pitting or step plating. Solutions not containing wetting agents have a tendency to float oil to a stagnant corner, depending on the recirculation pattern set up by the pump. Brightener breakdown products formed during plating also cause defects in the deposits physical properties and must be removed. Continuous carbon purification can control these contaminants.

Any plater who has ever changed a filter with powdered carbon will agree that the use of granular carbon is the preferred method of purification. Carbon purification chambers are available for use with all makes and types of filtration systems and can easily be connected to your existing filter, per the illustration below.



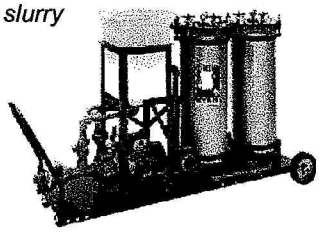

The choice of purification method depends on tank size, amount of carbon required, and other filtration equipment which may be available. Generally, carbon cartridges are used on tanks up to a few hundred gallons; bulk or canister type granular carbon is used for tanks of several thousand gallons. Granular carbon is also used as a separate purification system on the larger tanks to supplement surface filters, depth cartridges or certain

automatic filters. Quality of carbon is important. If needed, a sulfur-free grade of granular carbon is available.

Any filter surface or depth cartridge will operate longer without the need to clean or replace media if powdered carbon is not applied directly to it. Carbon used in an auxiliary method such as a granular carbon cartridge or granular carbon canister is the recommended approach. A carbon chamber piped in series following a filter used for solids removal and as a pre-filter to the carbon is the most effective and desirable method of operation. In this way, the carbon chamber handles a portion of the total flow. Thus, continuous filtration can be combined with a selective, separate and more efficient method of carbon treatment.

*This portable filtration system includes a slurry tank for pre-coating, and a filter chamber for removing solid particles and to protect the separate, in-line carbon chamber.*



Powdered carbon is, just as the name implies, an extremely fine powder and as such will, if not properly and completely removed, be as harmful a contaminant as the organic material it was intended to remove. Filtration in the 1 to 5 micron range is required to adequately remove powdered carbon.

## CARBON CARTRIDGES

A 2¾" diameter by 10" long carbon cartridge contains approximately 4 to 8 oz. of activated carbon, depending upon its style of construction and whether it is granular or powdered carbon. The cartridges are also available in 20" and 30" lengths and fit most chambers using replaceable cartridge type filter media. Those using granular carbon have an outer pre-filter and an inner trap or polishing filter which sandwich the activated carbon granules. Cartridges which incorporate powdered carbon provide an inert matrix binder which prevents release of the carbon fines, yet maintains porosity and maximizes carbon exposure to the passing fluid. They replace a conventional depth wound cartridge quickly and easily and are ideal for in-tank or submersible filtration systems where pre-coating with filter aid and powdered carbon would be impractical. Carbon cartridges are the most convenient method of bath purification.

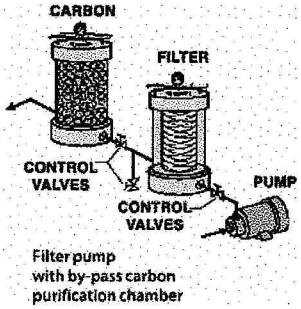
## CARBON CANISTER

Ready-to-use plastic 5" dia. x 28" long and 5" dia. x 48" long refillable containers hold 7 lbs. and 14 lbs. respectively of granular activated carbon and are placed in-line in carbon chambers downstream of the plating tank and filter chamber. A built-in 3 micron trap filter prevents migration of carbon particles. Pre-filtering ahead of the purification chamber prevents solids from coating the carbon surface, assuring maximum adsorbency. With a bypass valve on the filtration system, any amount of the filtrate can be treated as needed. Carbon in the canister can be replaced when its adsorptive capacity is reached. This method of separate purification has the most flexibility.

## BULK CARBON

Granular carbon is used loose in a canister, chamber or in a bag within a purification chamber. This method maximizes the amount of carbon exposed to the solution and offers the longest operating life before replacement is necessary.



Filter pump with by-pass carbon purification chamber

## CARBON PRECOAT

Powdered carbon is co-deposited with the filter aid on the pre-coat surface of the support membrane, which may be cloth, paper or a depth type filter cartridge (which becomes a surface medium when pre-coated or for conversion to an easily cleanable surface filter media, the filter cartridge can be replaced with a sleeve assembly.) Use a slurry tank to first re-circulate the liquid through the filter, and then add filter aid until the solution is clear. Finally, add a mixture of equal amounts of filter aid and powdered carbon. This purification method can be used continuously or intermittently. It is considered by many to be the quickest way to affect adsorption due to the large surface area provided by powdered carbon.

A depth or surface type filter cartridge may be pre-coated immediately prior to the addition of carbon. The same method is used for batch treatment. Granular carbon can be used, but the rate of adsorption is not as rapid as for powdered carbon although, pound for pound, the adsorbency is comparable.

## BATCH PURIFICATION

Complete batch purification in a separate treatment tank is only necessary if day-to-day in-tank carbon purification proves inadequate. Just as in the case of batch treating for solids removal, the warm solution is pumped into an auxiliary tank. Powdered carbon is added in the required amount and agitated for an hour. Average powdered carbon dosage is 4-6 lbs. to treat 1,000 gal. of warm plating solution. Sprinkle an adequate amount of filter aid over the top of the solution. As it settles, carbon will cling to it and after settling, the solution may be decanted by inserting a suction hose near the top of the solution, gradually lowering it as the solution is pumped through a filter. Periodic checks of the discharge filtrate should be made to ensure that no carbon gets back to the plating tank. A very important consideration when batch carbon treating is to determine that the method of transfer filtering back to the plating tank provides adequate solids holding capacity.

## PRE-COAT FILTERS

While pre-coat filters can provide for very fine particle removal, they are subject to certain shortcomings, as platers have discovered. The pre-coat material, which is supported by the membrane, is subject to migrating or sloughing-off should any drop in differential pressure occur across the filter media. Also, the dirt-holding capacity is limited because the pre-coated material produces a very dense medium through which the liquid must pass. As the small pores are plugged with dirt particles, the flow is gradually reduced until it stops completely. The filter cake must then be removed and replaced.

This requires a certain amount of know-how and experience - not to mention lost time and expense.

In order to have a reasonable amount of time before it becomes necessary to clean the filter, platers oversize the pre-coat filter to provide sufficient dirt-holding capacity. In practice, servicing would then be required anywhere from a few days up to several weeks.

## VERSATILITY OF CARTRIDGE FILTRATION

Platers then sought other means to lengthen the time cycle between filter cleaning. They determined that, with coarser filter media, the flow rate through a given area is higher and the dirt-holding capacity is increased.

Various types of filter media are available, but the fiber-type wound cartridge offers the greatest flexibility in porosity (1 to 100p). Thus, the optimum porosity in relation to the size and number of particles to be removed can be selected to achieve longer operating periods and less servicing of the filter.

Because of their depth, cartridges increase the effective filter surface five-to-seven times compared to a flat membrane with filter aid. They are available in cotton, polypropylene, rayon, glass and other fibers for a variety of applications. The polypropylene cartridges are suitable for most plating baths. It is recommended that they first be flushed with warm water to remove residual lubricant. To facilitate cartridge changing, they can be obtained in 10", 20", 30" or 40" lengths to fit various size chambers. Precision-wound, cartridge-type filters also offer the advantage of dry disposal with little solution loss and, overall, a clean and simple method of operation with maximum economy.

## IMPORTANCE OF FLOW RATE

Initially, 25-30 years ago, the cartridges selected were capable of 3-10µ particle retention, because it was felt these particles caused roughness. Experimentation later showed that slightly coarser; 15µ cartridges could be employed with equal success. The flow rate across the filter increased because the filter media was coarser and less restrictive.

Today, many platers have found that by increasing their pumping rates from less than one tank turnover per hour to three or more turnovers per hour, they can use filter media as coarse as 30 to 50µ. At the same time, the net pressure drop is reduced by about 50% and a substantially higher flow rate through the filter is achieved with the same pump. The increase in cartridge porosity also increases the dirt-holding capacity before the filter needs to be serviced; on certain alkaline solutions which have slimy contaminants, filter media as coarse as 75-100µ are now used successfully for weeks at a time.

In order to achieve long intervals between filter servicing, it is necessary to employ a filter media as coarse as possible; but this alone will not do the job. Flow rates at sufficiently high tank turnovers are required to make coarse filtration work. This same high flow rate creates the velocity necessary to carry particles off the bottom of the tank

and into the filter, in much the same way as some swimming pool operators use vigorous agitation in order to avoid costly manual vacuuming to clean pool bottoms.

## ADVANTAGES OF COARSE FILTER CARTRIDGES

Earlier, it was noted that particles in the 3-10µ range can cause roughness. How then, can a 50, 75 or even 100µ cartridge achieve the clarity required to maintain quality plating? It should be pointed out that coarse cartridges are not limited to the removal of large particles only. As the outer cartridge surface becomes loaded with particles, the openings grow smaller and smaller. More and more of the smaller particles are retained by this gradually forming "pre-coat".

Cartridges are rated according to their ability to remove a minimum of 90% of the particles contained in a test sample of either fine (FAAD) or coarse (CAAD) Arizona-air dust to meet a given micron rating. While a 50p cartridge will remove 95% of 7 5µ particles, it is also capable of removing 50% of smaller particles, and even 5% of 5µ particles.

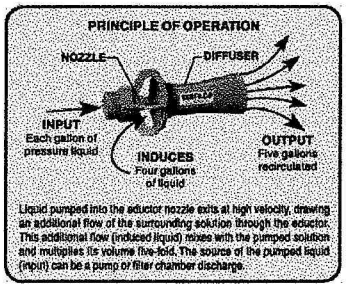
As an example, if you attempt to filter dirty river water through a filter with a 75µ ~ cartridge, you will see little evidence that much is accomplished on a single pass through the filter. But, on each succeeding pass through the filter, a very small percentage of fine particles are removed. As the filter cartridge picks up these finer particles along with coarse particles, the cartridge itself becomes denser and the percent of finer particles removed on a single pass through the filter is increased until, finally, virtually all of the particles are retained on the filter.

Obviously, when a plater circulates solution in a still tank in which a lot of solids have settled and pumps them through a coarse filter, he cannot immediately produce high quality work. The solution must be re-circulated through the filter a number of times before quality plating can be performed.

Filtration of plating solutions with filter cartridges as media has had some other beneficial effects. Solution losses, as pointed out earlier, are minimal because the cartridges can be flushed with water and returned to the bath. Seal life in the pumps is greatly improved because filter aid, which is abrasive, is no longer employed. When seal life of the pump is improved, losses of solutions due to leakage are prevented. Also, priming problems are minimized because, if a seal is tight, it does not allow air to be sucked into the pump, which would cause cavitation and make pump priming difficult.

## AGITATION

A method of agitating the plating solution with a combination of high flow centrifugal pumps which draw solution from the tank and return it through a sparger system similar to that used for air agitation is now being used worldwide. Rather than just perforating the pipe, eductor nozzles are strategically placed



along the pipe to direct solution across the bottom or sides of a tank and into the recesses of the parts to replenish electrolyte.

Agitation in a plating tank must accomplish three major requirements:

1. Circulate and disperse maintenance chemicals throughout the bath.
2. Maintain bath chemistry throughout the tank without stratification or depletion of components in a given area of the bath.
3. Enhance the deposition rate by replacing metal ions being deposited with fresh ions at the surface of the work.

Benefits of eductor agitation in plating applications also include:

- Eliminating misting and fumes caused by air agitation — a cleaner and safer environment.
- Eliminating bath contamination from air blowers — cleaner bath, less rejects.
- Reducing oxidation of bath chemistry — better plating quality
- Reducing heat loss and preventing temperature stratification — lower heating costs
- Reducing gas pitting — less rejects

In addition to plating applications, eductor agitation can be used in pre- and post-treatment tanks as well. The success of these operations may also be dependent upon good agitation, whether it is for a cleaner tank, rinse tank or other process tank. Proper agitation of cleaner, rinse or other solutions keeps soils and other unwanted solids in suspension where they are more easily removed by the tank's filtration system before they migrate to subsequent steps in the process and result in costly rejects.

The ideal combined filtration - carbon treatment system will have a pump and filter system sized to provide 2 to 10 turnovers per hour of the solution. On the discharge of the filter, a valved split in the flow will allow 80% to 95% of the flow to return directly to the process tank. The other 5% to 20% will be gently introduced on top of a granular carbon bed and allowed to slowly traverse down through the bed, out the bottom and back into the plating tank.

Plating quality can be improved by removing as many particles and contaminants from the bath as possible; continuous filtration and purification offers the best means of accomplishing this. Depth-type cartridges are efficient filter media, with maximum flexibility in porosity and fiber selection. With re-circulatory filtration, coarser cartridges are preferred to provide higher flow and dirt-holding capacity. Separate carbon chambers are recommended for purification in order to control the treatment at the optimum level required.

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