CLARIFICATION OF SOLUTIONS IN THE METAL FINISHING INDUSTRY

With today's emphasis on quality to finishing plastic and metal substrates and the need to follow ISO 9000 procedures and minimize waste from your processes, has placed a new emphasis on separating solids from liquids via filtration. Experience taught us that when roughness was evidenced it most likely was cause by particles which somehow found their way to the finishing solution (paint, electroless, electroplating). We tried to solve the problem with a filtration system.

The point is, all solutions involved in surface finishing have a place for filtration. This starts with the honing and grinding of a metal shaft which is ultimately going to be chrome plated, or aluminum extruded shapes which are going to be anodized, or steel stampings, die castings and screw machine parts which might be heat treated, and even plastic parts which are to receive a decorative or functional coating. Consequently, clarification of all solutions involved in arriving at the final finish, whether for decoration or a more functional purpose, such as wear resistance, lubrication or electronic conductivity, must be reevaluated.

Many years ago, painting or plating solutions were often were subjected to only periodic batch treatment, or particles were simply allowed to settle. The very small particles which didn't settle were often codeposited. Over the years, however, we have all seen how the applied coating has not held up due to atmospheric conditions and/or application requirements. Unfortunately, such failures could not readily be detected in advance by the microscope, or with life tests in a salt spray, or by other measures to determine thickness, etc. Therefore, failures could only be traced back to particles that we didn't see or feel, but whose presence could be detected by such means as the old silk stocking test on a nickel plated bumper.

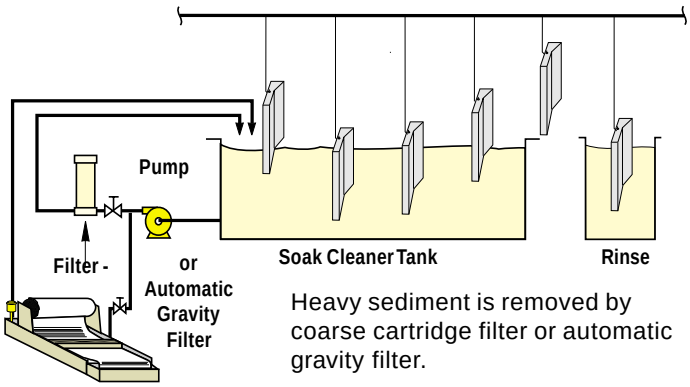
Plating for zero rejects demands an electrolyte free of solids and organic contaminants. Thus, today's plater recognizes that good housekeeping, better cleaning, and purer anodes and chemicals are basic essentials. Filtration, therefore, is the assurance that codeposition won't take place. Platers know that deposition from an electrolyte which contains solid particles will eventually cause a reject, and everything which can be done toward achieving zero rejects in this competitive world must be done. Platers also recognize that up to 70% of service problems are caused by impurities in the bath.

Consequently, platers realize the importance of filtration and how it can save them thousands of dollars of lost production . . . but. . .what do they do about it?

Platers were being asked to produce results while they seemingly had no measurable control over factors contributing to contamination in the baths. . . kind of like buying more and more life insurance which would be beneficial to someone else while giving the buyer some satisfaction during his/her lifetime even though its real benefit cannot be determined before he/she dies.

There is, however, a tangible benefit to the metal finisher who employs filtration to extend the life of the coolant. There is a monetary return to the heat treater who, with filtration, minimizes the cleaning of the tubes in the heat exchanger and, more importantly, makes the cleaning job prior to phosphating and painting or plating, easier, In years past, the problem of clarification of subsequent processes in surface finishing was solved simply by dumping the solution, much like the housewife dumps dishwater in the sink.

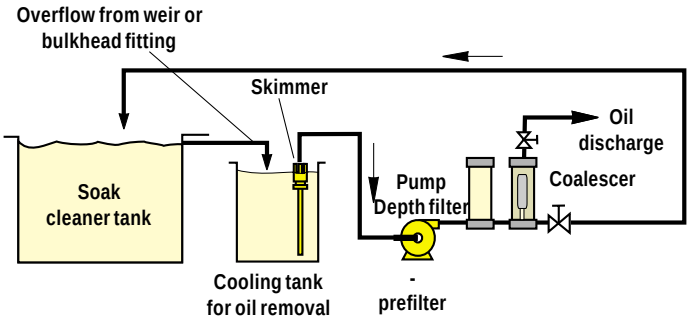
Figure 1 - *Filter your cleaners*



Heavy sediment is removed by coarse cartridge filter or automatic gravity filter.

Today, platers recognize that the life of cleaners, rinses, etchants, etc. can all be extended through the use of various means of solids separation from the liquids, in addition to liquid/liquid separation to remove oils by coalescing, and/or final adsorption of other impurities through the use of carbon, thus preventing contamination of the solutions used to electrophoretically apply paint, anodize or plate.

Figure 2 - *Remove oils*

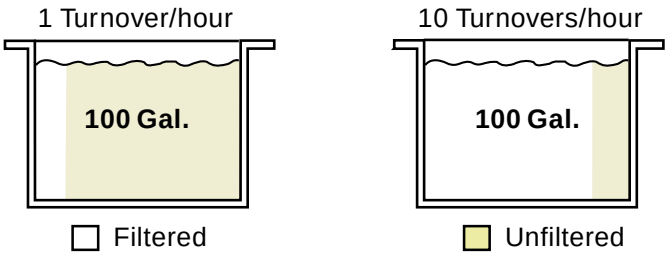


Oil is most effectively removed off line by feeding overflow weir to unheated side tank. Cooled cleaner is skimmed, prefiltered and coalesced. (NOTE: Pump can be in-tank or out.)

Fortunately, there are measurements which indicate to the plater when his solutions are or aren't within suitable tolerances for the purposes intended. There are, of course, also ways in which a cleaner or rinse tank could have the parts per million of insolubles measured. They make it possible to discontinue operation until the solutions have been returned to acceptable limits. The practical way to approach the problem is to remove the particles as quickly as possible in each stage, so that when the parts are carried to the next stage, surface tension doesn't cause the particles to cling and contaminate subsequent rinse, acid etchant, plating or other finishing solutions.

Platers must recognize that the particle separation which they achieve as a result of the filter they use, is only accomplished in the amount of liquid which passes through the filter over a given period of time. Unfortunately, plating is done in a volume of liquid much of which hasn't passed through the filter during the past 20 or 30 minutes. This is why care must be taken to provide the necessary solids holding capacity within the filter to maintain the desired flow rate, measured in turnover rate, over an extended period of time.

Figure 3 - *Turnover Rate*

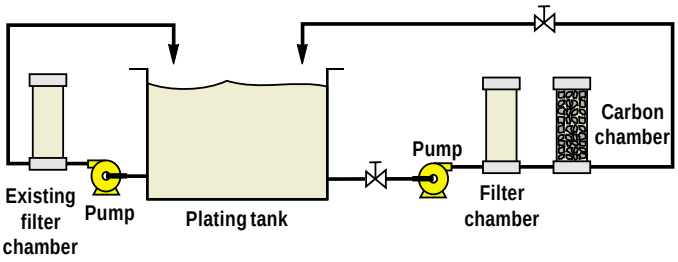


Comparison of filtered volumes for 100 gallons of solution after five minutes filtration at respective turnover rates

When filters require servicing each week and start at one or two turnovers per hour, they probably are providing only one turnover per hour in the middle of the week, and very little at the time of servicing. Therefore, the amount of particles so small that they can't be seen with the naked eye will probably not be removed at a constant rate in proportion to the amount which enters the finishing solution.

Platers who monitor the pH of their solution, the temperature, the amount of agitation, the additives and metal content, need to include a means of particle removal which will give them a constant parts per million of contamination well below that which would cause ultimate failure in years ahead. This is especially important to remove the quantity of particles the plater can't see during operations.

Figure 4 - *Balance your plating solutions*



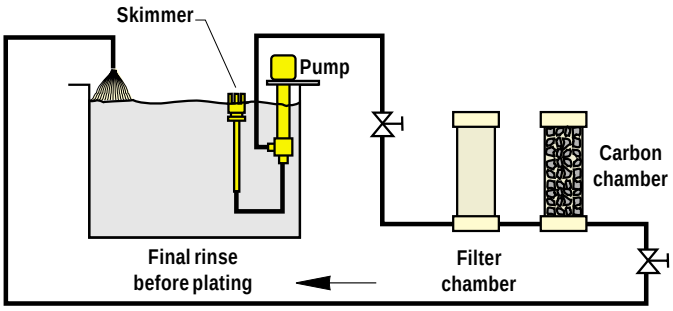
Your existing filter may be inadequate to prevent roughness. It may need weekly cleaning. Balance your plating solution with clean agitation, chemical uniformity and additional clarification. A SERFILCO filter with optional carbon chamber will dramatically increase dirt holding capacity. This can extend time between cartridge changes by 2 to 3 months and also keep organics under control.

When selecting a filter, the most common parameter is dirt load. Years ago, the filter was sized to the application according to surface area. In such situations, with a narrow range of particle sizes, surface type media might perform better, whether in the form of a pleated throw-away type cartridge, a bag, a cleanable sleeve, a paper or cloth disk. Some types of filter media lend themselves to backwashing for the purpose of renewing the filter media. Other forms of filters take the shape of gravity or pressurized surface models which are automatically indexed to minimize servicing. (See Figure 1). However, the introduction of wound type filter cartridges increased the dirt holding capacity with the phenomenon known as 'depth type filtration', wherein the particles are separated by a series of graduated densities. This, of course, worked well, especially when the contaminants themselves ranged in size so that all would not be rejected at the

same level, thus blinding off the flow.

However, when considering all of the above, the plater must keep in mind the most important goal, and that is to continue to maintain or improve a given level of quality over an extended period of time, be it Monday to Friday or the first of the month to the end of the month, etc. Ideally, if the cleaner is passing particles on to the etch tank, then care should be taken to increase the clarification of the cleaner. If oil is moving from tank to tank via surface tension, it must be skimmed along the way, coalesced and/or removed with carbon, so that it does not have to be dealt with in the plating tank. Surely everyone would agree that it is easier to carbon treat the final water rinse before plating than it is to remove oil once it gets into the plating tank.

Figure 5 - *Filter the last rinse with carbon prior to plating.*



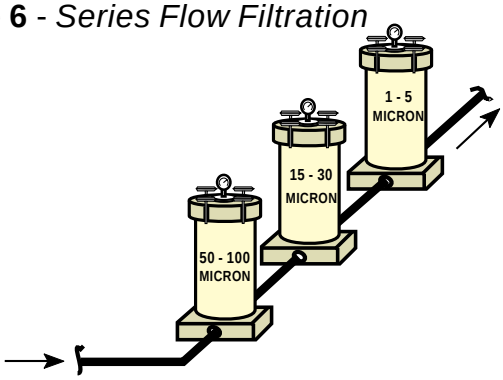
The final rinse before plating, whether after electroclean or acid dip, is your last chance to remove oil and particles before they reach the plating tank. (NOTE: Pump can be in-tank or out.)

Again, if the acid etchant is passing particles on to the next rinse, clarification and filters are a means of prevention.

For instance, a recent article in a magazine referred to the fact that impurities in an anodic film were causing slightly different shades of color. It stated that impurities in the rinses or in the anodizing solution were perhaps being absorbed into the anodic film. Stains could also have been caused by improper sealing, or sometimes through insufficient agitation during anodizing. Chemical supply houses will often suggest or recommend a micron rating for a filter. However this number, usually mentioned in microns, is a nominal size and only relates to the percentage of such fine particles which the media used for filtration would be capable of stopping on a single pass.

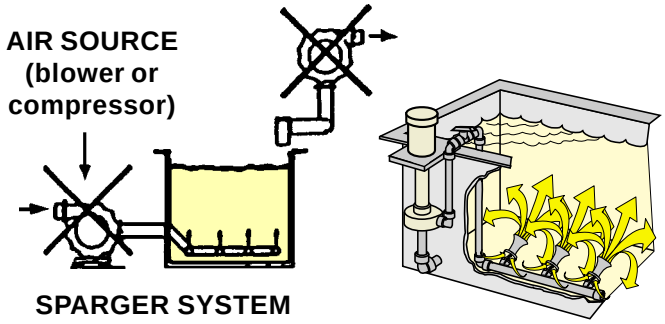
On the other hand, when filtration is used to stop bacteria in blood, beer or to other highly critical applications, the micron rating is referred to with the word 'absolute', meaning that no particles in either dimension, length or width, could fit through the pores of the media. Such filtration has the advantage of separating the extremely small solids on a single pass through the filter media. In such cases, the surface life of the media can be extended through prefiltration, which might require, or be accomplished in two, three or four stages.

Figure 6 - *Series Flow Filtration*



Platers might also recognize that another suspected source of contamination is the low pressure blower, which brings atmospheric air containing vapors into the plating tank at the precise moment that deposition is occurring. In-tank agitation through the use of pumps and eductors could avoid this sort of contamination and, in turn, reduce the need for solids holding capacity in the filter.

Figure 7 - *Air vs. Air-less Agitation*



Tank ventilation and air agitation can carry unwanted contaminants from other operations into the plating tank.

Eductors multiply pump agitation 5 times to impinge recesses.

Therefore, consider the fact that the pump must, first of all, move a given amount of liquid so that the contaminants which get into the plating tank can be removed in a timely manner.

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Secondly, in addition to having a sufficient amount of surface or dirt holding capacity in the filter, it is important that the pump create a sufficient amount of pressure to maintain the desired flow rate over the desired life between filter servicing. Keep in mind that when a filter/pump system is purchased to deliver 1,000 gallons (or liters) per hour to create a turnover rate of three, four or even ten times on a given tank size of 250 down to 100 gallons (or liters), this flow rate must be maintained until the filter media needs to be cleaned or replaced.

As a matter of information, it should be noted that small filter systems usually employ pumps which may only develop from 6 to 12 psi (less than 1 bar), whereas the very largest of systems might develop between 38 and 45 psi (2-4 bar)

Another important consideration with regard to the pump is whether or not the impeller will be magnetically coupled to the motor and thereby operate without a seal, or employ a single or double water flushed mechanical seal, or have no seal at all as is the case of a pump immersed vertically into the liquid.

Of concern to the plater, is the possibility of introducing finely dispersed air which becomes entrained in the plating solution. This phenomenon can occur after a seal has been used for a considerable amount of time and becomes worn. Thus, when a filter is clean (that is, when the pump is flowing at its maximum), air can be drawn in. The same phenomenon can occur from the rotating shaft of a vertical pump unless sufficient backpressure is available in the discharge piping so that the problem is minimal, or the pump is so constructed to break the vortex of the rotating pump shaft. The presence of wetting agents can accentuate the problem.

Finally, in addition to pump selection, considerable care must be taken to see to it that the filter has sufficient dirt holding capacity to operate fro extended periods of time. Therefore, the type of the contaminants to be encountered, such as would occur in a slimy alkaline zinc, acid zinc, nickel iron, or fluoborate solution, must be considered, so that additional surface or solids holding capacity is provided or frequency of backwashing is increased.

To summarize, all solids/liquid separation applications can be broken down into a mathematical equation. Particles measured by size and number are present in preliminary metalworking processes. The number of particles which enter a given tank must be removed at the same rate to maintain the clarity which, in turn, achieves the desired quality. Turnover rates help bring particles to the filter more quickly to avoid codeposition. If particles are allowed to cling to the part to be plated, codeposition could take place and premature failure could occur.

Platers would do well to recognize that a turnover rate of ten times per hour, which provides 1,000 gallons (liters) per hour on a 100 gallon (liter) size tank, will take six minutes for the entire volume to pass through the filter only once. Unfortunately, a single pass through the filter does not remove all of the particles from the solution. If a low micron surface filter or an absolute filter is used, it will plug up very quickly. Filtration results will be less than desired. Therefore, higher turnover rates, more dirt holding capacity, two stage filtration, or preventive steps which eliminate the particles from getting into the finishing solution, must be accomplished.