Basics of Filtration

By Jack H. Berg

Nearly every liquid used in electroplating—and surface finishing in general—requires filtering to remove particles of all kinds of impurities that somehow find their way into the tanks. These particles can cause all sorts of problems, from clouded plating solutions to outright rejection of plated parts.

The size of undesirable particles is usually very small. Most are measured in microns [*i.e.*, 0.0000394 in., or millionths of a meter (μm), a meter being 39.37 inches]. Filters are now made that are quite effective in catching these very small particles and removing them before they can cause problems. Even city water, which we drink without even thinking about it, must be filtered for some applications.

Flow Rate

Flow rate through a filter is important. If the rate is too slow, particles can mix with the metal ions of a plating solution and be deposited along with the metal and cause problems, such as roughness on what is supposed to be a smooth plated surface. It may be necessary to employ continuous recirculation through a filter to remove all or most of the particles. If the content of a plating tank is completely pumped out and refiltered once, it is called a "turnover" and may be done periodically or continuously. In actual practice, the solution is not pumped out, but merely recirculated to the tank.

The rate of tank turnovers should be considered in the specification and selection of filters, as well as pump pressure, solids holding capacity, compatibility of the materials of construction with the solution to be pumped and filtered, and service requirements. Typically, turnover rates used in the plating industry range from 1 to 10 times the volume of solution per hour.

Figure 1 illustrates a typical pump used to force fluids through the media in a filter and back to a plating tank if that is the desired destination. [Other destinations can include a carbon purification chamber (used to remove organic contaminants, but which can be used in an intermittent or continuous mode with particle filtration) or coalescing chamber for liquid/liquid separation, for example.]

The most important point to make about filtration with regard to plating solutions is that if contamination is prevented from entering the solution in the first place, filtering of the solution is unnecessary. This is a theoretical point because it is impossible to prevent all contaminants from getting into the plating tank, but it is definitely a consideration in plating system design.

Filter Types

There are many types of filters and physical arrangements. The two most common filter media are cartridges, discs, bags and sleeves. They are manufactured from a variety of materials and each can be specified for the largest size of particle that can be allowed to pass. Other types of filters include sand and gravity-fed fabric models.

Cartridge filters are cylindrical in shape, with a hole or tube core down

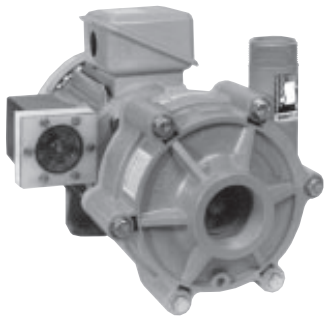

Fig. 1—Typical pump used to force fluids through the media in a filter.

Fig. 2—Filtration system that employs discs & provides automatic backwashing.

the center. The filter chambers in which the cartridges are used are often designed for easy removal and replacement of the cartridges. The liquid to be filtered enters the chamber containing the cartridge(s) and works its way from the outside of the cartridge to the center, then out of the chamber. The filter medium of a depth-type cartridge is wound around the core in a pattern that leaves diamond-shaped holes that get progressively smaller from the outside to the center. It is the winding closest to the core that determines the particle size rating of the filter because this winding is the densest (has the smallest holes).

Disc filters are arranged in stacks, much like pancakes. The incoming liquid surrounds the stack and flows over each disc, then through the filter medium on each disc to a plastic form that drains to the center of the stack. Bag filters are exactly what the name implies. They are bags that filter the solution as it flows from the inside to the outside. Unlike vacuum cleaner bags, they do not puff up as they fill with solids. Once the interior surface of the bag is covered with solids, the bag loses its filtering ability. Sleeve filters are like stockings fitted over a cylindrical form. Like cartidges, they filter solution from the outside to the

inside and, like bags, lose their filtering ability once the outer surface is covered.

Ultimately, any type of filter will become clogged with trapped particles and the flow will be reduced. This condition is indicated by an increase in pressure in the filter chamber. At this point, the filter (cartridge, disc, bag or sleeve) must be removed and cleaned or replaced. (Most platers change filter media based on a predetermined pressure limit.) In some cases, the cleaning of cartridges can be done by backwashing, but because most cartridges are disposable, the operator simply replaces them with new ones.

As with other areas of modern technology, efforts have been made to eliminate labor and media disposal by designing permanent media filtration systems for the plating industry. Such a system is shown in Fig. 2; it provides automatic backwashing. Variations of this unit can be used for filtering cleaning solutions and plating baths, as well as for polishing treated waste. P&SF

About the Author

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