



SERFILCO®

Maintenance and Operations of Filtration Systems

The proper operation of your filter system is essential to maintain the high quality levels demanded of finished products in today's market. Statistical process control techniques are being utilized to monitor critical parameters of plating processes, and the filtration system's proper functioning is essential to maintain high levels of purity in the process. Not only are higher levels of purity required for quality production, the equipment used in recycling and recovery solutions necessitates higher removal rates of particulates by filtration, and organic contaminants by carbon adsorption, since very little will escape the system due to drag-out. The logical place to assure this purity is in the plating tank where the benefits to maintenance quality are a direct result as opposed to separate filtration just to protect membranes, ion exchange columns, and other equipment used on the drag-out rinse system.

The proper maintenance of a filtration system starts with defining the objective of filtration and purification, selection of equipment and accessories that will provide those needs, and planning an installation that can be easily maintained.

The Basic System

The basic filtration system consists of a pump and motor and a filter chamber with filter media, interconnecting piping and valves; and, quite often, a separate carbon chamber for continuous carbon treatment for organic removal. Accessories, such as slurry tanks for priming and additions or precoating media, are required for some systems. Other optional accessories to monitor and control the filter system are available.

Ideally, the filter system will be in a location that will protect the equipment from the environment and be easily accessible for service and maintenance. Precoat systems usually require more space than cartridge filters, and consideration should be given for easier access, since they will require more frequent servicing and the handling of powdered filter aids and carbon (which may be airborne or otherwise will end up in the process tank).

The location of the system should be such that the pump is as close to the tank as possible. Long suction lines to the pump can result in cavitation,

especially with higher temperature solutions. Ten or fifteen foot suction lines the same size as the pump inlet should not be a problem. Longer run lines may require an enlarged suction line—consult your supplier.

All restrictions in the suction line should be avoided. A 90° elbow is equivalent to five feet of two-inch pipe. Also, keep in mind, when piping through the wall of a tank, that a valve at the tank will be installed and that a rubber lined 2" flange may have 1½" ID. The suction line should be located in the tank so that air from the sparger is not pulled into the suction line. The suction and discharge lines should be located to provide cross circulation of the tank. Also, protection against fallen parts plugging or restricting the inlet should be provided.

Start Up

Prior to starting the pump, the valves on the suction side should be open to flood the pump. This is a good time to check for leaks which may not be apparent when the pump is running, since there can be a negative pressure on the solution side of the piping system. When the pump is turned on, check for noise and vibration, which can indicate bearing problems or cavitation.

When a pump operates at high rates, low pressure develops at the eye of the impeller. If this pressure is below the vapor pressure of the liquid, vaporization occurs. The bubbles formed subsequently collapse causing damage to the impeller, seals, bearings and shaft. The higher the temperature of the solution pumped, the more likely this can occur.

If the pump is cavitating, throttling the discharge will decrease or eliminate the noise. Under no circumstances should the pump be operated in this condition, as rapid catastrophic damage can result. Check for restrictions in the suction lines, or leaks, which can pull air into the pump with much the same effect as cavitation. This will also result in air entrapment in the filter chamber. Entrapped air or cavitation prevents proper lubrication of mechanical seal faces.

Mechanical Seals

The most common problem which pump and filter systems encounter is mechanical seal failure,

usually caused by cavitation or running dry. Eventually every seal will have to be replaced due to normal wear on the seal faces. This can be a matter of months or years, depending on the application. In any case, leaking seals should be replaced immediately before further damage and solution loss result. Leaking seals can cause motor damage. Leaking seals will soon come totally apart causing damage to the shaft, shaft sleeves, and even impellers and pump housings. Replacing seals every year, or if experience warrants, a shorter cycle, is a good preventative maintenance practice.

down the pump shaft. The power from the motor is transmitted to the impeller by a magnetic coupling through a non-magnetic pump casing which allows the liquid to be completely sealed in the pump housing. The rotating impeller magnet assembly is supported with internal bearings, shaft and thrust washer, which are lubricated by the material being pumped. High solid loading or abrasive solids cause excessive wear. Also, magnetic particles (iron filings) can adhere to the rotating impeller magnet, turning it into a grinding wheel, which eventually can harm the housing.

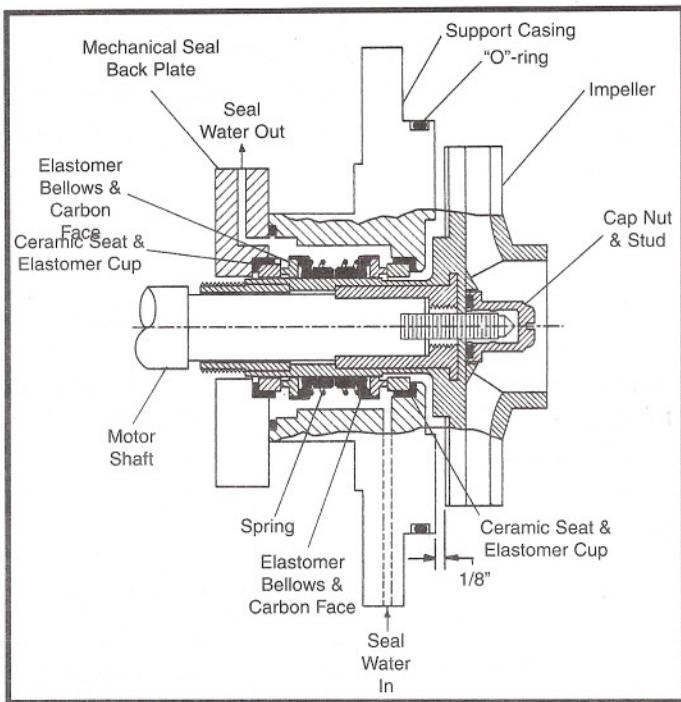


Fig. 1. Horizontal pump with double water flushed seal.

All mechanical seals are lubricated by a thin film of liquid between the stationary and rotating faces of the seal. This film evaporates at the outside edge of the seal, leaving salt crystals behind. Double water flushed mechanical seals as shown in Fig. 1 offer additional protection for seals by providing a source of clean fluid to flush abrasives off the seal faces as well as preventing crystal formation on the outer edge of the seal face, which eventually causes wear.

Seal-less Pumps

Magnetic coupled seal-less pumps (see Fig. 2) avoid many of the problems of pumps with mechanical seals since there is no source of leakage

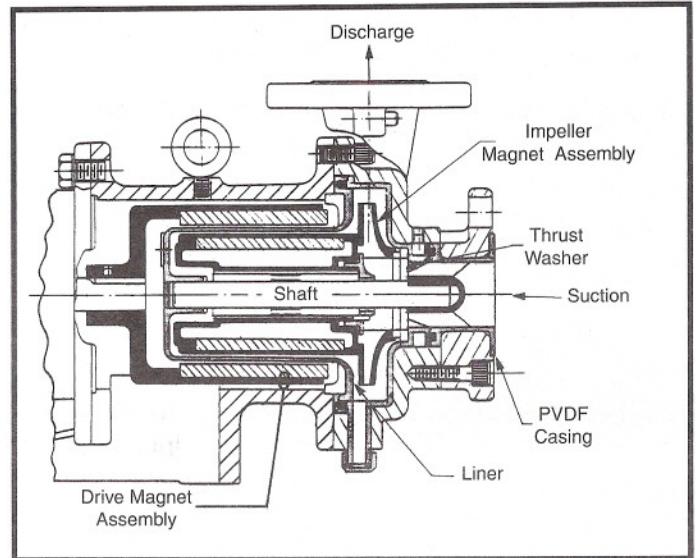


Fig. 2. Magnetic coupled seal-less pump.

Axial and radial play due to wearing of the bushing and thrust washer will result in vibration and noise, indicating immediate attention is required. Some designs provide circulation channels through the impeller magnet for cooling and lubrication to the rear of the impeller magnet. If these passages become plugged with solids, damage to the bushing and impeller magnet assembly will occur. Inspection and replacement of worn parts every year, or more often if experience dictates, is recommended. Since these pumps have bearings, running dry can cause severe damage, except in new designs which have some dry run capability.

In-tank Pumps

Vertical in-tank pumps (see Fig. 3) are widely used on many installations since they have no bearings in contact with the solution being pumped. This avoids the problem of plate-out on the bearing or seal faces which would damage the pump. Also any

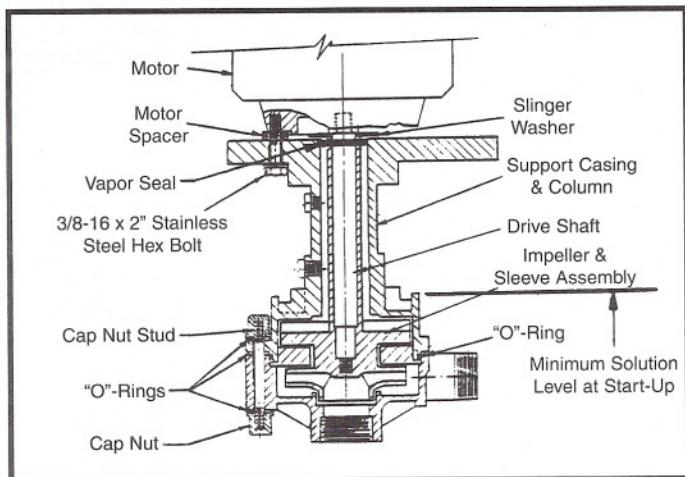


Fig. 3. Vertical cantilevered shaft pump.

leakage that might occur is contained in the tank; however, the motor could be subjected to fumes and dripping solution from the racks, so precautions should be taken to minimize this with ventilation ducts or baffles to keep the motor dry. Vapor seals at the top of the pump shaft should be tight or replaced to ensure isolation of the motor bearings from fumes or liquids that might travel up the shaft.

Vibration and noise indicate problems and should immediately be investigated. Undue stress from the piping system can cause misalignment of the pump column with the pump shaft, resulting in rubbing of the rotating member against the housing. Broken impellers due to ingestion of the parts into the pump can throw it out of balance, as with all centrifugal pumps. Build up of salt crystals in the pump column or plate-out can eventually cause damage. Routine operating procedures should be established for stripping or flushing should this be a problem.

Protective Shut Down

Protective devices for horizontal pumps are available that will shut the pump down in case of loss of prime or loss of seal water pressure or flow. In the case of double water flushed seal pumps, these devices sense either flow or pressure and are tied into the magnetic motor starter for the pump. Some magnetic drive pumps are available with a device that senses the position of the impeller magnet inside the casing and will shut the pump down when operating outside the optimum range. These devices are designed to prevent damage in the case of operator error or some unforeseen system failure.

Pump Curves

Several types of filter chambers are available, either the cartridge type, the simplest to operate and maintain, or precoat types, such as horizontal disc, vertical tube or plates, and bag filters, to name a few. One thing they all have in common is that they have an initial clean pressure drop and some maximum pressure drop indicating minimum flow. These two pressure points are dependent on the individual pump and its piping system. A pressure gauge on the pump side or dirty side of the filter is a useful device for monitoring the condition of the filter. Observe the clean pressure reading when first starting up the system. Comparing this reading to the pump curve will give an approximation of the clean or open flow. The maximum pressure (cut-off head) of the pump will be zero flow. This can also be determined by throttling a valve on the discharge side of the chamber. Actually, the filter should not be allowed to run at more than about 80% of the cut-off head of the pump, since the flow at this point will be insufficient to maintain the desired purity in the tank. Using this pressure gauge is the simplest method to monitor the filter. Either mark the gauge at the pressure the filter should be serviced, or make a log of the pressure reading each day.

A sheet of paper with the date and pressure reading taped to the chamber can be very revealing. This log can be used to estimate when the filter should be serviced, and that information should also be noted. This pressure-time history is useful because an unexplained drop in pressure may indicate a bypass situation caused by a failure in the media, or a pump problem. Likewise, an abnormal increase in pressure could indicate an accumulation of gas in the chamber reducing the filter area. Venting the chamber will cure this problem. There could also be a blockage in the filter discharge, or an unwarranted heavy dirt load, that should be looked into.

Lack of increase in pressure should also be highly suspect, since it probably indicates that the filter is not doing its job. We actually had a case where a filter chamber had been in service for six weeks or so with no increase in pressure observed. A curious operator opened up the chamber to find no media inside. Having the historical data in graphical form, as in Fig. 4, can be an invaluable aid in preventing small problems from getting out of hand.

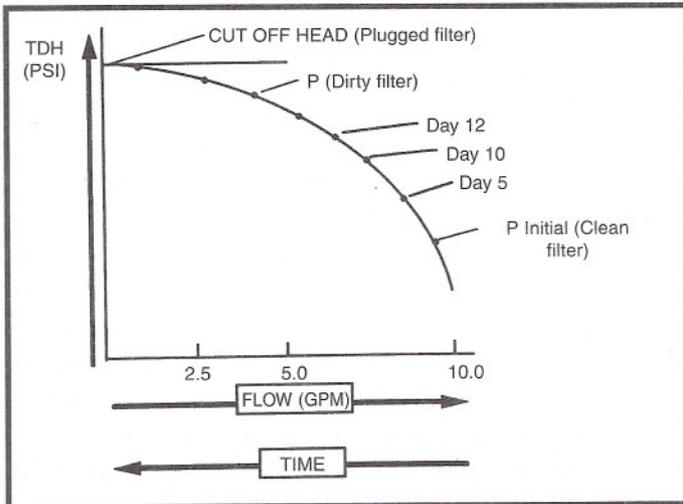


Fig. 4. Typical centrifugal pump curve. As the media becomes loaded the pressure rises. Permanent media filters which monitor the flow with a meter are available to automatically backwash the filter at the desired flow.

Other Considerations

In addition to monitoring flow and pressure, checking the clarity of the tank and the discharge of the filter is, perhaps, so obvious as to not be worth mentioning. If the filter discharge is clear and the flow is normal, yet the tank purity is not sufficient to maintain quality, you have a problem. Assuming good cross-circulation, then increased flow rate (or decreased dirt load) is required.

Several options are available depending on the type of filter system. An additional filter system or larger filter should be considered. Another possibility is to increase the flow rate of your existing system. If the filter is plugging rapidly, its average flow may be increased by going to coarser media without harming clarity. Going to denser media, which reduces flow, is not the answer in this case. Increasing the pump capacity may be possible. Most likely, this will require replacing the impeller and motor, which is not a major operation. Adding a second filter chamber in parallel with the first is a possibility.

If your system is a precoat filter, and you are using powdered carbon, remember that the carbon is dirt load to the filter and reduces capacity. A separate granular carbon chamber can be added onto a bypass system to the discharge of any filter system

for improved filter performance and better control of carbon treatment.

Regardless of the type of filter system used, certain good practices should be maintained. Protective clothing when handling media or servicing the filter is a good practice. Good housekeeping including washing down solution spills from the exterior of the equipment prolongs the life of the equipment. Prompt repair of leaks is a must. Plastic piping tends to leak at pipe threads when temperature changes and fitting with "O"-rings can seal these troublesome pipe joints.

Whenever a filter is opened for service, inspect the "O"-ring, tube seats and media for holes, chips, etc., that can result in bypass or leakage. Inspection of the chamber lining periodically may reveal small failures which can be repaired before damage to the chamber necessitates total replacement. Good access and lighting are important.

Many plating solutions crystallize on cooling. If the filter is to be shut down for any length of time, it is desirable to dilute the solution in the filter so that this does not occur. One way to do this is to pump make-up water to the plating tank through the filter at the end of the shift. These crystals can damage pump seals and impellers, and will plug granular carbon beds until dissolved.

Conclusion

Detailed operation, service, and maintenance information should be provided when you buy equipment. Careful attention to these instructions can prolong the life of the equipment and reduce maintenance. If there are any questions, consult your supplier. It is a good idea to have him check over your installation and be there on start up if possible. Don't overlook the list of recommended spare parts. Maintaining your filter purification systems is more critical today with the effect it can have on the recycle and recovery equipment as well as the quality of plating.

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