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- Metal Finishing Series -

In-Tank Filtration Systems

FACT SHEET

This fact sheet, which discusses advantages and disadvantages of in-tank filtration systems, is one in the Fabricated Metal Products (FMP) series produced by the North Carolina Division of Pollution Prevention and Environmental Assistance .(DPPEA). The series also includes Bag In-Tank Filtration Systems, Cartridge Filtration Systems. Disk Filtration Systems, and Identifying and Reducing Contamination in Metal Cleaning. Plating, and Rinsing Baths. These fact sheets are designed to assist industry professionals and others interested in waste and cost reduction opportunities associated with fabricated metal operations. Please contact DPPEA at (919) 715-6512 for assistance or additional information.

Uses and Advantages of In-tank Filtration

The use of in-tank filters can be effective for removing and controlling many of the contaminants that accumulate in plating process tanks. These filtration systems are primarily used for particulate removal but can also be combined with carbon to remove organic contaminants. Depending on the process, the metal finisher can extend the plating/cleaning solution life by two or even four times through the use of in-tank filtration systems. Not only does this system improve the cleaning and plating quality of the operation, but in many cases, it saves expensive treatment/disposal costs as well as virgin chemical costs. Pay-back periods are commonly less than one year. As the list below shows, there are many advantages to in-tank filters compared to no filtration systems as well as to an out-of-tank system. [1]

- Particulate filtration reduces the need to desludge tanks. Less frequent sludge removal reduces losses in production time, solid/hazardous waste problems associated with sludge disposal, and virgin chemical costs associated with bath make up. Bath make up often requires the purchase of acid passivators, cleaners, oxide baths, chromate conversion coatings, and iron phosphating chemicals.
- In-tank filters reduce the need to batch-purify solutions in a holding tank because continuous or intermittent carbon treatment can be done directly in the process tank.
- Labor demands are reduced with in-tank filters. Conventional out-of-tank systems often require a significant amount of labor and time. The smaller, simpler in-tank filters are designed for rapid filter media changes, e.g., hand tightened thumbscrews and reusable filter media.
- In-tank filtration reduces the overall waste treatment load as baths are dumped less frequently.
- Because the unit is contained in the tank potentially hazardous and costly leaks and spills are eliminated. Much of the apparatus associated with an out-of-tank system such as pipes and pumps can leak solution onto the floor. With no spills, in-tank filters translate to a reduction in chemical costs for solution replacement, cleanup, and disposal.
- Solution residue must be cleaned from the chambers and pipes incorporated with an out-of-tank system. Usually, this residue must be managed as hazardous waste. As the in-tank filters contain no piping or separate chambers, the residue clean out and disposal problems are eliminated.

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- In-tank reusable filter media can be quickly removed from the solution, rinsed of contaminants, and ready for reuse in a short period of time. This reuse reduces the replacement and disposal cost associated with non-reusable media on out-of-tank systems.
- An adjustable outlet port on in-tank filter systems can be directed to provide continuous circulation of the solution within the tank. By providing continuous agitation and particle capture, this circulation and filtration combats both sediment build up on the tank bottom and oil accumulation on the tank Surface. It is possible that this circulation will eliminate the need for separate air and mechanical agitation systems. A circulating solution also helps keep bath temperature and composition homogenous.

In-Tank Filter/Solution Compatibility

In-tank filters can be used in most plating/cleaning solutions with some exceptions. Filter life generally varies with the type of solution and the type of material used. To ensure the long working life of a filter system, it is necessary to use a material that will not break down in the plating/cleaning solution. Common filter unit construction materials and compatible plating/cleaning solutions are listed below!

- Filter systems made of chlorinated polyvinyl chloride (CPVC) plastic are compatible with most of the common acid and base solutions used in the metal finishing, printed circuit, and related industries at temperatures up to 200°F. However, chromic acid plating baths at high concentrations will cause plastics to crack, craze, split, warp, or become brittle.
- Both highly alkaline, high-temperature solutions, and alkaline zinc plating solutions may cause premature cracking and crazing of the CPVC in one year or less. If a particular bath is known or suspected to result in damage to CPVC, a polypropylene system should be used.
- Filter systems operating in solutions at temperatures over 200°F should be constructed of PVDF (Kynar) material, a more expensive, high-temperature plastic. Kynar can easily add 50 percent to the price of an in-tank filter system. However, the agitation provided by an in-tank filter system may permit the operator to lower the temperature to a point at which a less expensive material is adequate. An agitated solution operating at a lower temperature is frequently more effective than a hotter, stagnant bath. Vendors claim that in some plating baths that generally operate at 2OO°F, increased agitation has permitted bath temperature to be lowered to 185°F, thereby reducing energy costs and evaporation from the tank.
- Permanganate solutions operating at about 180°F are used in the printed circuit board industry. These solutions are very destructive to CPVC, polypropylene, and even Kynar. They attack plastics aggressively and quickly. For permanganate baths, a stainless steel filter system should be employed.
- When brass, bronze, silver (cyanide), tin and zinc (cyanide) solutions are used, the pump model and body length must be properly sized to avoid aeration, which can lead to the formation of precipitates in the solution.
- For electroless copper and zinc (alkaline, non-cyanide) solutions, a polypropylene pump material should be used.
- In electropolishing operations, a high-density material is required to pump the viscous, high-specific gravity sulfuric/phosphoric acid solution in the in-tank unit.

Table 1. F'ilter Media

Material	Application	Unacceptable applications
Polypropylene (reusable)	Most metal finishing up to 200¤ F	Chromic acid-containing baths
Non-poly propylene modfied polymer (reusable)	High solid loadings (i.e., cleaning baths), Chromium-containing solutions up to **350°F**	None
Polypropylene (disposable)	Most metal finishing up to **200°F**	Chromic acid-containing baths

The filter media itself are also susceptible to degradation by certain solutions, as shown in Table 1 .[3] The many types of filter material include cotton, polypropylene, non-polypropylene modified polymer, modacrylic, CPVC and PVDF.

Organic Contaminant Removal Through In-Tank Filtration

The in-tank filters will remove particulate matter as well as help disperse tramp oils. The efficiency of the filter will depend on several factors including surface and pump capacity. In-tank filters can be successful in reducing more problematic organic contaminants with the aid of carbon.

Advantages of In-Tank Filters With Carbon Aid

- The in-tank process provides continual cleaning, which eliminates downtime. The process also maintains organics at appropriate levels, which is accomplished by either replacement of the filter cartridge on the in-tank fiter system with a carbon-treatment attachment or using a multiple cartridge unit that allows normal and carbon-treated media to be utilized in the solution at the same time. Thus, without interrupting the production run, carbon treatment can be administered continuously during plating to polish solutions prone to rapid build up of organics[4]
- It is also possible to batch treat a tank overnight, thus making it ready for operation the next day. Mechanical stirrers applied during batch treatment will improve the efficiency of the removal of sludge from the bottom of the tank and its collection in the filter media.[5]

Table 4 lists in-tank filter vendors.

Table 4. In-Tank Filter Vendors

Vendor	Telephone
Serfilco®, LTD	(800) 323-5431
Flow King	(407) 331-4634
Camac Industries	(201) 575-1831
Penguin Pump Industries	(818) 504-2391

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The North Carolina Division of Pollution Prevention and Environmental Assistance provides fee, non-regulatory technical assistance and training on methods to eliminate, reduce, or recycle wastes before they become pollutants or require disposal. Telephone DPPEA at (919) 715-6500 or 800-763-0136 or e-mail nowaste@owr.ehnr.state.nc.us for assistance with issues in this Fact Sheet or any of your waste reduction concerns.

DPPEA-97-15. 125 copies of this public document were printed on recycled paper at a cost of $9.00 or $0.072 per copy.

[1] Horvath, Gene. In-Tank Filtration/Solution Purification: A New Concept in Waste Minimization.
[2] Flow King. Solution Notice. Flow Ring Brochure.
[3] Flow Ring. Guidance on Selecting Filters Cartridge. Flow King Brochure.
[4] Horvath, Gene. In-tank Filtration/Solution Purification. *Printed Circuit Fabrication,* Vol. 13, No. 5, May 1990.
[5] Horvath, Gene. The Reason for In-tank Filtration. *Products Finishing,* Vol. 53, No. 5, p. 103, Feb. 1989.