SERFILCO®

Continuous or batch clarification
In-line or recirculatory installation

TECHNICAL
BULLETIN
TF-119A

Question - **How to achieve the solution clarity desired at the lowest possible cost**

Answer - **Recirculate the liquid through the filter and back to the process tank until all particles are retained in the filter media.**

A proven approach to an old problem

This approach will prevent solids from settling in the tank from which you are drawing the unfiltered liquid. Your goal is to end up with a process tank full of clean liquid and a filter filled with the retained solids. This can be accomplished if you direct filtered solution back to the process tank and recirculate until all the particles are in the filter, leaving the process tank ready for the next batch.

Recirculation has other benefits. Let's say a certain type of filter media stops most, but not all, of the solids that must be retained. A second, third, or fourth pass through the filter may produce the desired result.

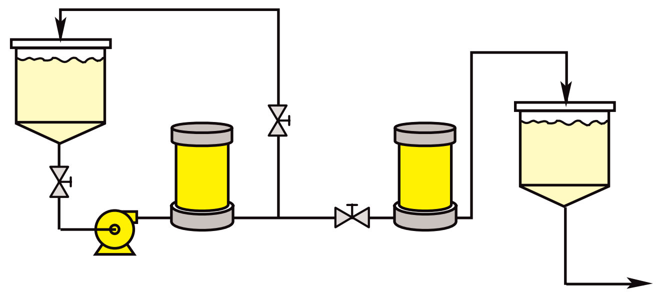
For instance . . . if a filter media having an efficiency of 90% retention of 5 micron particles is used, it also is removing some lower percentage of finer particles, let's say 50% of 3 micron. If the porosity of the media didn't change, you could expect to pick up an additional 50% of the 3 micron particles on the second pass, now leaving 25%. (50% of 100 = 50, 50% of 50 = 25). Therefore, with constant recirculation, it is possible that all of the 3 micron particles could be retained in the media.

There is, of course, the effect of increased density caused by the collected particles on the media which may speed up or increase the percentage of retention, or their presence may hinder the flow and slow down the flow rate. This would suggest that a media which may have been too dense was used.

Filter media with a broad range of porosities lends itself to recirculatory applications. Consider the possibility of using coarse filter media instead of fine on any of your applications. Permanent or throw-away media, with or without filter aids or various types of cartridges, can all be applied with various degrees of success.

Often the filtration process may be started even during the mixing or dissolving of ingredients, providing that the porosity of the media is not too dense. The velocity of the liquid passing across the retained solids will cause them to dissolve quicker. If not, the retained solids become a filter aid assisting in the stoppage of finer particles.

A significant benefit of using less dense media to achieve the desired particle retention is the increased solids holding capacity offered by coarser media. Coarse media may provide up to five times the solids retention before flow is reduced to an unacceptable rate, or if monitored, recirculation may be used until a desired clarity is achieved, at which time the valves (see diagram) are moved to direct the clean liquid to the clean storage tank. Additional recirculation of the clean tank may also be done and a second trap filter using denser media may also be used. (See diagram)



As an increased amount of solids are picked up by the filter as a result of turnover, clarity is improved.

Will it work?

Well, it is already being done and has been for years by many other industries. Swimming pools, hydraulic and lubricating systems, plating and other types of finishing processes usually don't have a "dirty" tank and "clean" tank so they rely on continuous recirculation of the liquid passing over the filter media until the desired results are achieved. The difference is that the application allows for some solids to be present in a limited amount until removed. This presence of solids could not be tolerated in such finished products as beer, whiskey, soft drinks, food oils and syrups, chemicals, etc., hence the need to either do a good job of filtering the first time, or recirculate until the desired clarity is achieved.

We are aware of many examples of success with coarse media. For instance, 30 micron cartridges will keep hydraulic oil looking like new, will change a neglected swimming pool from green to clear overnight and turn a slimy-oily alkaline zinc solution from milky to clear. It all depends on the number of passes which dictates the flow rate required.

For instance, a 1000 gallon batch being filtered at10 GPM would take one hour and forty minutes to process and 100% contact with the filter still couldn't be achieved. If we turned the tank over 10 times in one hour to achieve 100% contact with the filter, a pump of 167 GPM would be required. At this rate, only one hour would be required for turnover recirculation. Result, the process tank would be clean, the solids would be in the filter, and the desired results would be achieved.

Therefore, if you are interested, discuss it with your supplier of filtration equipment or media. Find out what coarser media is available. Determine how recirculation will affect your process. Be sure there are no harmful side effects. Increase the size of your filter to hold the total amount of solids. (See commentary below.) Select the coarsest media possible by trial to get the maximum solids holding capacity, yet dense enough to achieve the desired retention. (Do it in stages if necessary. Coarse - then fine, etc.)

You will achieve solution clarity at the lowest possible cost!

Single Pass vs. Multi-Pass Applications

Retention ratings, by convention, are for single pass applications. Many applications involve recirculating systems. In recirculating systems, the filter media has several opportunities to capture the contaminant. For example, in a 4.0 gallon system circulating at 2.0 GPM, the fluid passes through the filter cartridge 5.0 times in ten minutes. Thus, the effective retention of a filter cartridge is much finer. Specifically, a cartridge rated at 0.5 mm (nominal) on a single pass is an effective 0.2 mm (nominal) filter on a recirculation basis.

Summary of Nominal Retention Ratings	
Single Pass	**Multi-Pass**
.5 μm	**.2 μm**
1 μm	**.5 μm**
3 μm	**1 μm**
10 μm	**3 μm**
25 μm	**10 μm**

FILTER CHAMBER SIZING & ITS RELATIONSHIP TO SOLUTION CLARITY

In addition to the question of in-line or recirculatory installation of a filter for your solution, chamber sizing can make a significant contribution to the economics of the filtration process.

Chamber Sizing / Oversizing

Select a filter chamber for its solids holding capacity. The size and amount of dirt in the solution will determine the number of cartridges or surface area necessary, with one 10" (25 cm) cartridge (3.5 square feet), or 2/3 sq. ft. of surface for each 50 gallons (200 liters) of solution used as a rule of thumb. The flow rate should be 2 - 30 or more tank turnovers per hour on recirculatory filter systems, depending on the application and the clarity desired. Coarse media and high flows are desirable for high dirt load applications. Increasing the number of cartridges reduces solution flow per cartridge, improves efficiency and reduces cartridge consumption. Filter cartridge solids holding capacity is increased if flow rate (velocity) through each cartridge is decreased. Therefore, reduced flow rate or velocity through the cartridge reduces the number of filter cartridges consumed by a given dirt load. Thus, when 2 cartridges per 50 gallons (200 L) are employed, cartridge consumption is reduced by 29% and when 4 cartridges are employed, cartridge consumption is reduced by 50 %.

Oversizing by a factor of 4 doubles the solids holding capacity per cartridge. Since the chamber holds 4 times the number of cartridges, the filter is opened only 1/8 as often, reducing the labor by 87-1/2% for cartridge changing. Increasing the size of your filter chamber is particularly worthwhile since most filter chambers are offered in larger sizes at only a slight increase in cost. Oversizing also results in a savings in downtime and prevents solution loss.

ECONOMICS OF FILTER CHAMBER OVERSIZING

Oversizing Factor	Number of Cartridges in Chamber*	Dirt Holding Factors per Cartridge	Time Between Cartridge Change	Cartridge Consumption/Cost Reduced by:	Labor Cost Downtime/ Solution Loss Reduced by:
1	C	D	T	0	0
2	2xC	1.4D	3T	29%	67%
3	3xC	1.7D	5T	42%	80%
4	4xC	2D	8T	50%	87½%

For example...

using a **12** cartridge filter	instead of a **9** cartridge filter	reduces cartridge consumption by **13%**
9 "	**6** "	" **18%**
6 "	**3** "	" **29%**
9 "	**3** "	" **42%**
12 "	**3** "	" **50%**
15 "	**3** "	" **55%**

* Based on average sizing [i.e. 1 - 10" (25cm) cartridge per 50 gallons (200 L]

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