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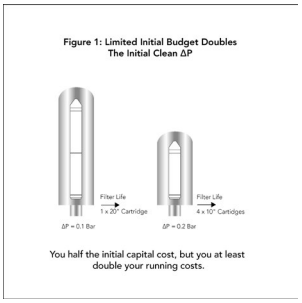
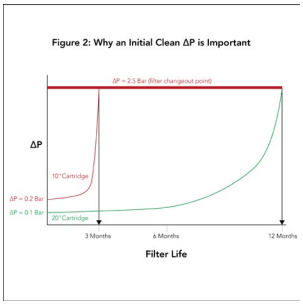
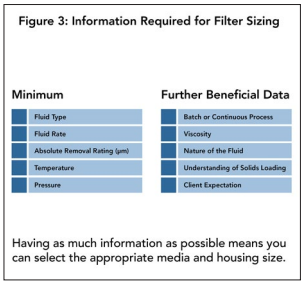
HOW TO ENSURE THAT YOU SIZE FILTRATION SYSTEM TO GIVE THE BEST COMPROMISE BETWEEN INITIAL CAPITAL OUTLAY AND LOW RUNNING COSTS







It is easy to imagine that the smallest filter that can handle the flow rate of a liquid would be the best choice for a filter system. However, this is only the case if you solely consider the initial purchase costs and ignore the operating costs of replacing filters each time they block. On the other hand, having a filter system that is so large that the filters never need changing, so operating costs are negligible might seem a better solution.

In practice the optimum situation for the majority of customers is one where the initial purchase cost is balanced against operating costs to give the most cost effective life time solution, also known as total cost of ownership.

Within this article, we will discuss how you achieve this and provide tips on how to ensure you optimise your filtration system. Finally, we will cover the optimum sizing of gas filters, which is different to liquids. Although both liquids and gases are fluids, they are different types of fluids. Liquids are non-compressible, whereas gases are compressible and this leads to them having to be treated differently.

What are you optimizing for?

The three main considerations for selecting the optimum sized continuously running filtration system are:

- Low initial capital cost – This often happens when the end user is asking a supplier (e.g. building contractor) to provide a system that includes the filtration system. Such a supplier may just want to minimise the initial purchase price as will not be around to pay the running costs.
- Low operating cost – if your system is going to be installed for a long time then the annual cost of replacing filter cartridges multiplied by the number of years of use can be many times the initial cost.
- Available budget – Sometimes you cannot buy the filter that is the optimum size because you to do not have the necessary capital budget available at the time (See Figure 1). In such a scenario, you purchase the filter that you can afford and accept what the running costs may be high!

Understanding differential pressure is key to understanding sizing

The key measurement for sizing a filtration system is the initial clean differential pressure (dp). Differential pressure is the measurement of the pressure loss that occurs across a filter system. This is easily measured on a system using pressure gauges placed upstream and downstream of the filter housing.

The lower the initial unused filter (clean) dp, the larger the initial capital cost of the filter system. Conversely, the higher the initial clean dp the smaller the initial capital cost of the filter system. However, as shown in figure 2, operating costs are inversely impacted by changes in dp. Doubling the size of the filters increases their life by a factor of four, therefore reducing operating costs. By comparison if you half the size of the filtration system you significantly increase the operating costs. Our recommendation would always be to invest in the lowest initial clean dp that you can afford.

So what is the correct initial clean dp to use? The answer is that it will always be a trade-off between capital costs and running costs. For a liquid filter system in continuous use, we would recommend choosing a value around 200 mbar as a starting place and revise, either upwards or downwards, as you see the initial cost of this solution.

Another important reason for installing pressure gauges, on your filter system, is that you then can measure exactly when the cartridges need to be changed, allowing you to maximise their lifetime and achieve the highest throughput per filter set change out. The typical change-out dp for a cartridge filter system is 2.5 bar and the closer to that dp when you change your filters the better you cost effectiveness becomes.

What is different about sizing for batch operation?

The main assumption above has been that we are running a continuous operating filtration system. However, there is another common operating scenario - batch operation. The key difference with batch operation is that your filtration system is going to be used intermittently to process a specific volume of liquid product.

Because of this difference, we can design with a far higher initial clean pressure drop, such as 0.5 bar or even 1 bar. Filter cartridge life only needs to last the duration of the batch and capital cost is driving the overall cost effectiveness of your installation. Knowing this can lead to significant savings on the initial capital outlay of a project for the end user.

Differences between sizing for liquids & gases

Although liquids and gases are both fluids, they are fluids of very different nature. The main difference that impacts filter sizing is that gases are compressible whereas liquids are not.

Therefore, when sizing gas filtration systems it is key to know the line pressure of the system. With a gas, if the line pressure doubles from two to four bar then the size of the filter system can be halved. The same change in pressure on a liquid system would have negligible impact on its size.

Differential pressure has far greater impact on the running costs of gas filtration systems, therefore they need to be lower than liquid systems. It is common to design gas filter systems with a clean dp of tens of millibar.

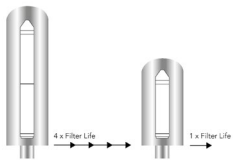
What do you need to know to size filters correctly? Is there an optimum way to size?

It goes without saying that the more information that you have regarding the process conditions the better the choice of filter that can be made to meet your selection criteria. Figure 3 shows the typical minimum requirements and other beneficial data that it is best to provide.

However, the importance of knowing the initial clean pressure drop cannot be understated. To leave this unspecified is to leave yourself open to confusion when you are trying to compare different filter options. It is important because you need to be aware of the initial clean dp used to size systems from different suppliers. If you don't know initial clean dp it is not possible to carry out a like for like comparison to ensure that you make the best selection for your application.

Buyer beware. The "cheapest" offer quoted is not always the "right" choice! The lifetime cost of your system is determined by your initial capital costs and your ongoing annual operating costs (see figure 4).

Figure 4: Doubling The Size Of Your Filter Extends Filter Life By A Factor Of 4



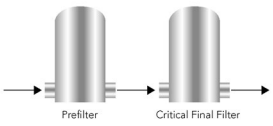
For a small increase in capital costs the cartridge costs twice as much so the running costs of the install have been halved.

The benefits of prefiltration

Even when you get the sizing of a filter system correct, due to the types of final filters required in critical applications (where membrane filters are often used) then running costs can still be very high.

Prefiltration of the final filter is a solution that can improve the overall economics of a filtration system used in a critical application. Using a prefilter will remove the greater part of the loading on the final filter extending its life significantly. Prefilters are normally 50% or less the cost of the final filter and should be expected to increase the final filters life by 2.5 to four times. This is shown in figure 5

Figure 5: Benefits of Optimised Pre-filtration



Prefilter	Number Used Per Year	Cost Per Cartridge	Prefilter Annual Cost	Number of Critical Filters Used	Cost Per Cartridge	Critical Filter Annual Cost	Total Annual System Cost
Xµm, Absolute	4	£100	£400	4	£200	£800	**£1200**
Xµm, Nominal	2	£50	£100	8	£200	£1600	**£1700**
No Prefiltration	0	£0	£0	16	£200	£3200	**£3200**

Often the easiest way to tell if a filtration system has been correctly optimised is by determining the ratio of prefilters to final filters. If that ratio is not greater than 2:1 then there is still scope to improve the economics of your filtration system.

Conclusion

In the above discussion it has been explained how important it is to know the initial clean differential pressure of your filtration system, its impact on the initial capital cost and your on-going operating costs. To help you here are a few do's and don'ts:

- Invest in the lowest initial clean differential pressure that you can afford.
- For liquid filtration, systems add height not width to a housing. Take the longest cartridges available, as this will minimise clean initial dp leading to longer filter life, lower operating costs and improved cost effectiveness.
- Whenever you are asking more than one supplier to quote, always ask them to specify the clean initial pressure drop that their filtration system has been sized upon in their proposal and confirm the absolute rating of their filter cartridge. This is the only way that you can get a true direct comparison of initial capital costs.
- Always fit upstream and downstream pressure gauges, so that you can accurately measure the filtration installations dp. This allows you to confirm that the initial clean dp quoted is achieved and allows you to accurately measure the change out dp.
- If using membrane filters to sterilise or stabilise liquids or solutions, then prefiltration is essential. As a rule of thumb, your use of prefilters to membranes should be 2:1 or greater. If not you are wasting money.

FILTRATION

Hilltop Honey Think Axium's Filters Are The Bees Knees

Axium Process recently supplied a number of 316L stainless steel Pure-Screen filters to award winning honey producer, Hilltop Honey, who are buzzing with success, distributing their products in swarms throughout the UK's major supermarkets, independent farm shops and delicatessens.

Founded in 2011 by young beekeeper, Scott Davies, Hilltop Honey has a passion for delivering the most exceptional tasting honey from all corners of the world. The recent implementation of Axium's wedge wire filters is to remove hive debris, which includes wort and fragments of wax, that occur naturally during the extraction process.

"Axium's Pure-Screen Filter is ideal for viscous products and offers a large surface area that results in lower frequency cleaning" states Hilltop Honey's General Manager, "a Technical Sales Engineer helped us select the best option for our application from a wide range of stainless steel filters and they have proved very effective in operation. The filter is adaptable allowing the use of interchangeable elements with different micron ratings, making it a very flexible solution for a number of operations throughout our process. The use of Axium's filters ensures that we can effectively remove any debris whilst retaining the world-renowned properties that naturally occurs within honey".

Axium's filters range from 5 micron up to 8000 microns as standard and can be customised to suit site specific or process requirements, from pump and instrument protection to critical applications where filter failure or collapse is not an option. The range, which includes standard, compact, 90° and in-line options, is available with interchangeable stainless steel wedge wire, sintered mesh and perforated tube screens.

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