

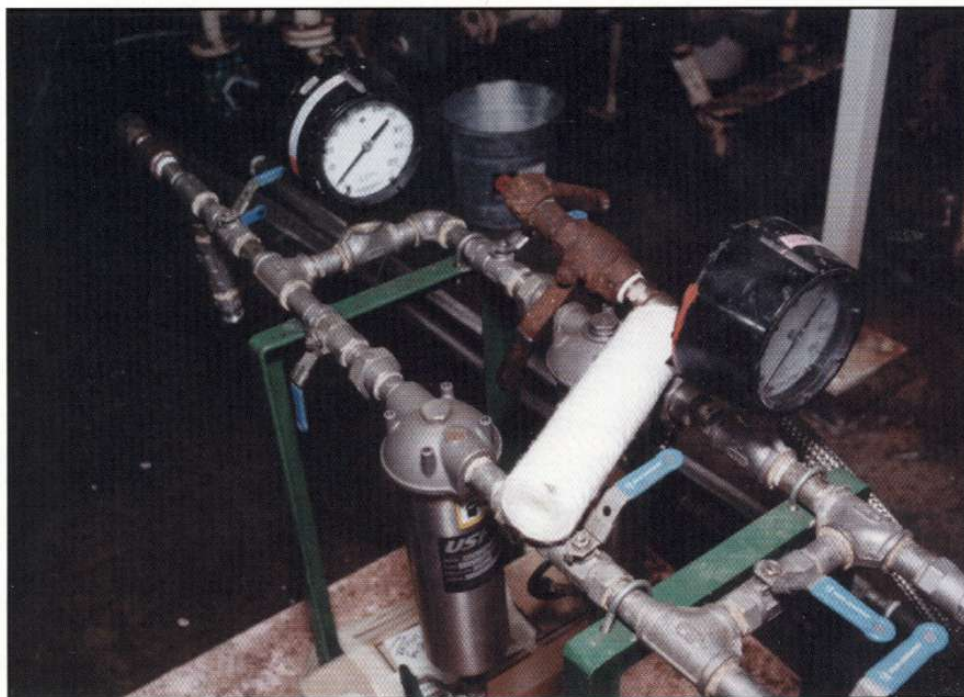
Calculating the Real Cost of Filtration

Understanding how filtration affects a plant's bottom line

By Keith Q. Hayes

Filtration unit operations within chemical manufacturing facilities often are almost an afterthought. Many designers and plant operators consider them to be much less important to their bottom lines than more "glamorous" unit operations such as distillation or reaction operations.

Unfortunately, discounting the importance of filtration can lead to major negative impacts on a process's profitability or even on a plant's ability to meet its customers' needs. Calculating the "real cost" of filtration can help a plant determine what engineering resources should be assigned to these unit operations.



The common string-wound cartridge shown here with the two cartridge housings can be found in most chemical plants.

Figuring filtration's real cost

Many filtration operations seem like bargains until plant personnel realize they are paying for many of the same things year after year. A simple method can be used to determine filtration's real cost.

Some sort of basis — or timeframe providing enough essential data — first must be assumed. The basis must be kept simple and should be based on likely and actual events. A year's worth of filtration expenses usually is long enough to capture most possible events, including infrequent events expected to occur again.

Equipment costs

The purchase price of the equipment itself must be considered next. (This step can be skipped if a plant wants to

look at only the current cost of its filtration operations.) If the plant wants to compare alternatives, it should do this for each possibility.

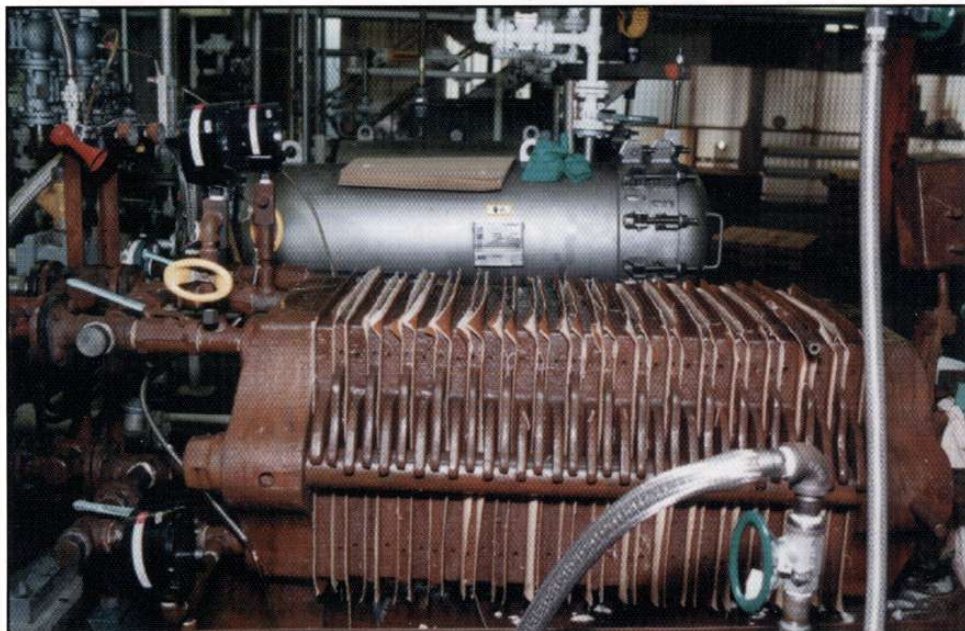
Equipment is a capital expense, and many project managers focus on avoiding these types of expenditures. Capital expenses alone, however, do not make up all equipment costs for filtration. In fact, some companies have become wealthy by selling filter elements, and sometimes will even give away the housings to get plants to buy their elements.

The following costs need to be considered:

- Capital equipment costs.
- Spare element costs.
- Installation costs.
- Auxiliary equipment costs.

Disposable element costs

The vast majority of filtration devices have some sort of disposable element that must be replaced. This might be a cartridge, a bag or something more exotic such as a coreless cartridge. A plant should determine how many of these elements are used during the time it has set for its basis. This number probably will be a function of factors such as the number of batches, clean-outs between products, the amount and size of particulate in the feed and the filtration rate. Operators usually have a good handle on this information. The number of change-outs should be recorded, along with the other significant production data. Automated software can be used to track the actual number of change-outs.



Plants may need to track lost time incidences resulting from potentially dangerous filtration equipment such as the filter press shown here.

Quality and productivity costs

Each time a filter fails or does not perform correctly, a plant needs to respond in some way. Filter failures can lead to rework, scrapping, slow-downs, customer complaints and other problems. None of these scenarios is pleasant, and all are costly. At the very least, every time a plant is not making material at its desired capacity, it is losing time and money.

To calculate filtration-related quality and productivity losses, plant personnel should track:

- Production time lost.
- Rework and scrapping expenses.
- Recall and customer complaint costs.

This calculation is one of the key parts of "total productive maintenance." Whenever a plant is unable to make product at the desired rate on time, it needs to track the problem and assign a cause. Often, some variability in the process upstream is responsible for upsetting the filtration operation and causing production problems.

Operator costs

This category looks at how much time personnel spend operating the plant's filters. Also, if the plant has a dangerous

filter operation — usually one involving a filter press and back injuries — it may need to track lost time incidences (LTIs). Operators should be safe while working so they can spend their time thinking about processes other than filtration.

To calculate true operator costs, plant personnel should track:

- Operator time spent on filter maintenance, failures and change-outs.
- The cost of operators' time.

Product value

Finally, a plant needs to apply some sort of measuring stick to determine how the costs of its filtration unit operations compare to the product made or to the value of the product sold.

With this in mind, a plant must determine:

- The mass of product made during the time basis.
- The value of product sold during the time basis.

Putting it together

Once a plant has collected all the information, it must convert it into some "dollars and sense." To do this, it should begin by determining the filtration-expense-to-product-value ratio. This

ratio is simply the sum of filtration expenses divided by the total value of product sold. This number should be as low as possible, and it can be tracked to measure improvement efforts. The definition of a "good value" will depend on the particular industry and product type. In general, a ratio of 0.01 or greater warrants further evaluation. This represents 1 percent of product value.

If a plant does have a high ratio value, it can use the same sort of methodology to evaluate potential improvements. This is where capital expenses come into play. Expenses for alternatives should be calculated and then compared using common economic evaluation tools such as return on investment or time to payback.

Once the information is in useful form, it is much easier for plant personnel to sell filtration improvement projects to management. And plant personnel develop an understanding about how the real cost of filtration impacts the plant's bottom line.

This method is not limited to filtration, however. The same logic process can be applied to evaluate other unit operations, including crystallization, distillation and reaction operations. The categories simply need to be modified. Such an evaluation gives plants a much better sense of what manufacturing technology and engineering mean to its profitability.

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The following information should help plants figure their true element cost:

- Cost per element.
- Elements needed per housing.
- Change-outs per basis timeframe.
- Cost of seals and other spare parts that wear out on a regular basis.

Waste costs

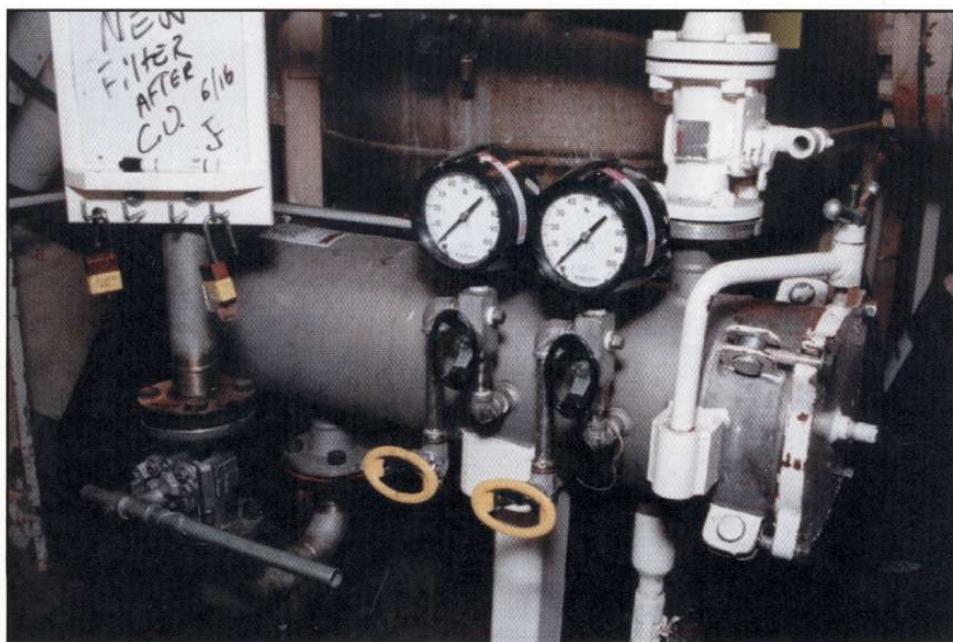
Not only does a plant have to pay for the required disposable elements, but it also has to pay to dispose of them. The type of waste and the size of the elements will dictate the number of elements that fit in waste pack. A purchase cost and a disposal cost are associated with each waste pack. Don't be surprised if the cost for disposing of the waste is greater than the cost of the element. Worse yet, waste costs must be included on environmental reporting statements, adding another task to plant personnel's busy schedules. Moreover, the information often is made available to the surrounding community, which likely will object to any and all waste generation.

A plant can use its environmental reporting records to calculate:

- The number of elements per waste container.
- The cost per waste container disposed of.
- The number of elements disposed of per year.

Lost product costs

Every time a filter element is removed for disposal or maintenance, a certain amount of product is lost. This material usually cannot be recovered and will end up as waste. Unfortunately, some materials are quite expensive, in a



This filter housing uses a coreless cartridge. The disposable element combines a bag filter's large capacity with a cartridge filter's absolute removal capability.



The disc pack cartridge element shown here is precoated with a filter aid to assist in the removal of small particles or second-phase liquids. This is a potential replacement technology for filter presses.

dollar-per-pound sense, and losing a small amount during frequent change-outs can be costly. A plant can calculate the costs associated with lost product by first observing the results of an element change-out. How much material was spilled? How much more does a dirty element weigh than a clean one? If the

plant is using a filter press, plant personnel also may want to consider how much material is lost to the slops pan.

Essential calculations include:

- The material mass lost per change-out.
- The cost of material per mass.
- The number of change-outs per year.