Factors to consider in liquid filtration

Selecting filtration equipment is the result of many considerations. Installed costs must be weighed against operating costs while waste disposal costs must be considered. Is continuous flow necessary or can the filtration equipment be operated intermittently? Such factors need consideration to ensure the right filtration method is implemented for the application.

The products being removed from a liquid process stream are as widely variable as the types of filters designed to remove them. Products being removed in potable water treatment applications are often molecular in size. However, many other filtration applications are concerned with the removal of specified trace solids from a liquid process stream.

Surface-type filters using fibrous cartridges or mesh screen made of woven wire or fabric are often used in these applications. This article will focus on the removal of these trace solids, rather than the entire scope of liquid filtration.

Optimal choice
There are many filter types to choose from when specifying an industrial application liquid processing filter. The optimal choice ultimately comes down to the technology that best meets the performance and operating cost needs of the application. Common filters include removable media types such as bag and cartridge filters and self-cleaning type filters. Each has advantages and disadvantages when compared with the others and the different types are appropriate for different applications.

Self-cleaning filters are most appropriate for applications where the process requires maximum uptime or little interruption, filter media replacement and disposal costs are high, the process fluids are valuable, and/or exposure of the process liquid to workers or the environment is undesirable.

There are several types of self-cleaning filters including backwashing systems that regenerate by reversing flow across a permanent filter media and mechanically cleaned filters that use a scraper to physically wipe particles from the media. Automatic backwashing filter systems can be used to remove suspended solids of approximately one micron or larger and work best with water-like liquid process streams at flow rates typically of several hundred to several thousand gallons per minute.

Industrial applications
Mechanically-cleaned filter systems can work with many industrial applications where viscosities or solids concentrations are higher but they generally have lower flow rate capacities than backwashing units and work best at retentions of 25 microns and greater.

All self-cleaning filter technologies are pressure filters (they have certain minimum operating pressure requirements) and they generate a waste.
stream that must be accommodated either by reprocessing or disposal. However mechanically-cleaned systems generally produce lower volumes of waste as a percentage of total process flow rate.

Disposable media systems such as bag and cartridge-type filters are available in many media compositions and retention rates, allowing for very specific solutions that are not available with more general self-cleaning units.

In general, bag and cartridge solutions are limited by the amount of surface area that can be applied to the filter application. Both types require a permanent filter housing to be installed to the process piping, which hold the media during the filtration operation.

Bags and cartridges must be selected from materials that are compatible with the chemistry and temperature of the process and they can remove suspended solids for applications with lower flow rates, where operator exposure to the process liquid is not a problem and where lower volumes of solids must be removed.

Bag and cartridge filters are roughly equivalent in price, while self-cleaning systems have higher initial costs. However, users should consider the total operating costs of the filtration system, not merely the initial purchase price. Media replacement and disposal costs, labor costs, process liquid losses and downtime should all be included when evaluating filtration systems.

Bag filters may be the most appropriate choice in many situations. These filters operate by capturing solids inside the filter media “bag,” which tend to be low-cost and generally have lower surface areas than comparable cartridge systems. Higher surface area and higher filtration efficiency bags are also available.

**Minimizing waste**

Bag filters tend to have the lowest equipment investment costs, and are generally tolerant of many process conditions, making them a good choice for a wide range of applications. For example, with small batch applications, the cost of a self-cleaning system may not be justified. In this type of application, process pressure conditions may not meet the requirements of self-cleaning systems or bag replacement may be so infrequent that disposal costs are not a significant factor in deciding which type of filter system to select. Bag filters generally produce less solid waste than cartridge filters so they may be appropriate in situations where users want to minimize the waste volume (especially when it is hazardous waste).

Cartridge filters operate by capturing solids on the exterior of the filter media “sticks.” Cartridges range from simple low-cost string-wound and resin-bonded units up to high-capacity pleated units available in many filter media types.

There are multiple standards for cartridge sizes and end connection configurations. Cartridge filters can be the logical choice for a wide variety of applications with varied flow rates that require sub-micron retention rating, including food and beverage, chemicals, paint and the filtration of acids and bases.

Cartridge filtration can also be an effective choice for pharmaceutical and ultra-pure water applications. Although cartridge filters generate more solid waste than bags and require more labor for media changeout, there are advantages with the variety of materials that can be used in them which is often a consideration in high temperature applications where metallic materials are required.

In situations where a cartridge filter user wants to convert to a self-cleaning system but cannot for whatever reason, bag filters may provide a compromise solution. Bag filters generate 10-15 times
• Adding a filtration system before a liquid passes through spray nozzles offers several benefits. Filtration prevents solid particles from reaching the nozzles, preventing unnecessary wear or blockage. Removing solid particles also prevents the passage of debris through the nozzles and into the process or on the products. Spray patterns and process quality are improved and defects reduced.

• A knife manufacturer was able to use well water instead of city water to cool their molding machines by adding a stainless steel self-cleaning filter. In order to make the switch, the well water had to be filtered to a level as clean as or cleaner than the city water. The self-cleaning system met the company’s water cleaning requirements and allowed it to save $25,000 annually in city water costs.

• In plastic molding and extrusion operations, cooling water readily picks up small plastic particles, limescale and airborne particulates, especially if the cooling water is kept in a central sump. Removing suspended solids from this cooling water results in decreased maintenance, downtime, equipment wear, and utility costs. Consequently, cycle times and production rates remain high, while rejects are minimized.

Careful consideration, when choosing a liquid filtration system, will offer numerous potential benefits. A wise filter selection can minimize process downtime, reduce or eliminate waste disposal costs, limit worker exposure to the process liquid, reduce maintenance time and expense, and improve product quality. As a result, it is important to review all the available filtration options and identify potential areas where adding or upgrading filtration can provide cost savings.

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Factors to consider
When selecting a filter for a particular application, the following criteria should be considered:

• What is the quality of filtration required?
• What are the conditions (flow, pressure, temperature) of the process?
• Is it a continuous or batch process?
• How large is the batch volume?
• What are the material characteristics of the solids being removed? (How large are the particles? Is the material hazardous? Can the material being removed be recycled back into the process stream at another point?)

Unnecessary expense
Many processors consider upgrading existing filtration systems or adding new ones an unnecessary expense. This is understandable since the solids in process fluids only occasionally cause catastrophic failures. However, the hidden costs created by contaminants are significant, while the cost to filter and remove them is modest and can be recovered quickly. Here are some examples of situations where significant benefits can be achieved:

• In some industrial applications, processors are incorporating pre-filters upstream of expensive membrane filtration systems. The pre-filter, typically either a bag or self-cleaning filter removes suspended solids that could prematurely foul or damage the membrane system.

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