Filtration techniques
Changes over time make disc filters a good option for treatment

by Miguel Gutierrez

Over the last decade, disc filters have been increasingly used in North America for municipal tertiary treatment, recycle/reuse, retrofit of conventional filters, and process water filtration. Elsewhere, they are also used for pretreatment of ultrafiltration (UF) membranes, product recovery, and industrial reuse. The difference in woven filtration media and flow pattern makes each type of disc filter unique to each application.

The two main disc filter techniques are outside-in and inside-out, which refer to the filter unit's flow-through scheme. Both techniques traditionally rely on filtration mediums that are configured in a flat panel design. Although different in material and construction, both filter mediums produce a pretty consistent effluent quality.

The backwash process in disc filters is initiated by headloss. High-pressure nozzle sprays dislodge accumulated solids, propelling them back towards the inside.

Two common configurations

The outside-in flow scheme is one of the earlier disc filter techniques used in North America. In this scheme, the discs are completely submerged. Solids are filtered on the outside of the filtration medium while filtrate is collected inside a drum and conveyed out of the system. Accumulated solids are removed by reversing a portion of the filtrate flow through a shoe attached to the medium while simultaneously rotating the whole drum/disc or just the backwash shoe on the stationary disc assembly.

Solids are captured and held by the randomly spaced and sized nylon fibers that comprise the pile cloth filtration medium. The cloth medium covers a honeycomb-shaped structure that is assembled around the filtrate drum/conduit.

There are several drawbacks to this technology. First, solids can sometimes pass through the pile media during high-pressure cleanings. Second, the medium matrix is constantly submerged in an ever-increasing concentration of feed solids, making it difficult for the backwash shoe to keep it clean. As a result, sludge withdrawal systems and additional high-pressure washing arrangements are frequently used in conjunction with these filters, sometimes further complicating the overall system.

Third, biological matter can also grow on the filtrate side of the filtration cloth, especially in unchlorinated filter feed/secondary effluents. Fourth, to initiate the high-pressure backwash cycle and to expose the spray nozzles, the filtration process must be taken offline. This can result in excessive tank drainage, lengthy rinse periods, and substantial reject volumes, as well as redundancy requirements for ensured continuous wastewater treatment.

The inside-out filtration technique addresses many of the outside-in technique's inadequacies. The former reverses the flow pattern by feeding the filtration medium from the inside, and partially submerging the outside of the medium in filtered water. Wastewater enters a central drum/conduit, where it is fed to the inside face of the filtration panels, which are assembled in a disc pattern around the drum.

Solids are deposited on the inside face of the medium, while filtrate is produced on the outside. Backwash is initiated by headloss and is effected by high-pressure nozzle sprays that dislodge accumulated solids, propelling them back towards the inside.

After being collected in a trough inside the drum/conduit, the solids are conveyed out of the system by gravity. The backwash spray is pulled from the same reservoir of product filtrate water in which the disc/drum assembly rotates.

The medium is a woven polyester cloth with an absolute-micron size rating that helps retain particles larger than the cloth opening size, as well as those greater than the available opening of the accumulation in the medium.

For tertiary reuse, this rating is typically 10 µm. This medium is assembled in filter panels, which are inserted into plastic boxes that surround the feed drum/conduit in a disc configuration.

Each disc is composed of 28 filter panels. Since the discs are in filtrate water only, there is no need for sludge removal mechanisms, resulting in a much simpler system.

Flat vs. pleated filtration panels

Both the inside-out and outside-in techniques rely on filtration mediums configured in a flat panel design – the pros and cons of which have been enumerated above.

In 2006, Siemens Water Technologies released an inside-out configuration disc filter with an innovative woven polyester pleated panel design.

This design increases the available effective filtration area (and thus, treatment capacity) by 40 percent over flat panel designs. Pleated media is also structurally more durable and can easily withstand much higher headloss conditions than other media configurations.

The pleated media panels are a molded one-piece construction with structural stiffeners through the centre of the panel area. This panel configuration is more resistant to cloth deformation and the eventual tearing common to cloth stretched in flat panel designs. No epoxy glue is used, eliminating the probability of cloth delamination. The pleated media design also offers quick-release cleaning, helping improve the cleaning process and prevent media wear.

The filtration boxes (the filtration panels' housing) are designed to be trash tolerant. Unlike existing flat panel technology, the Forty-X disc filter's filtration boxes do not contain internal gussets. This allows large inorganic material such as plastics, algae strings, rags and other floatables to flow through and be rejected from the system and to not accumulate and affect the internal hydraulics of the filtration panels.

Water pressure-assisted seals and stainless steel sliding covers make accessibility and maintenance easier. Leak points inherent in flat panel designs are minimized in the pleated filtration panel's seals by using water column pressure.

The sliding cover design of the disc/drum's internal assembly eliminates the need to lift a heavy cover – a benefit especially for outside installations in windy areas.

The disc filter's higher filtration surface area, combined with its stronger configuration, results in a high throughput capacity, better feed distribution, and fewer backwash frequencies. The disc filter's design also serves as an ultimate barrier for suspended solids in tertiary treatment processes.

The Siemens modular design offers flexibility for a broad range of flows and applications including water reuse, tertiary filtration and process water filtration.

The Forty-X disc filter's modular and all-inclusive design allows for an easy and economical retrofit to existing structures. The Forty-X disc filter has also received Title 22 approval, meaning it complies with the existing State of California Water Recycling Criteria that requires filtration technologies to reliably meet specific performance parameters for wastewater reuse applications.

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