Choosing The Right Side Stream Filtration System For Your Cooling Tower Water

Separators, traditional media filters, automatic screen filters, micro filters (cartridge & bag) and high efficiency media filtration systems all offer an effective way of removing particles from the circulating water. Each of these filtration technologies offer differing benefits and associated costs. Understanding your application and the available technologies is necessary in choosing the right side stream filter for your cooling tower needs.

Selecting the right side stream filtration system will depend on:

- The quality of make-up water added to the system.
- The type of contaminants already in the system and/or being generated within the system.
- The operational duty or objective of the system.
- The current chemical treatment program.
- The cycles of concentration at which the system is operating.
- The maintenance and operating requirements.
- Budget constraints.

The selection process in choosing the right filtration system should be made in conjunction with a specialist and/or a filtration system supplier/manufacturer.

Review of Side Stream Filtration Technologies

Filtration Technology	**Particle Removal**	**Applications**	**Maintenance and Operational Costs**	**Backwash Costs**	**Energy Costs**
Centrifugal Separators	Nominal 100 microns	Removal of large, heavy particles. Lowest purchasing cost. Small footprint.	Purge or backwash components require routine inspection. Must be online 24 hrs/day.	Minimal	High – requires a high pressure to operate correctly 24hrs/day.
Traditional Sand Filters	Nominal 10 microns	Used in removal of particles ≥10 microns (low density particles).	Media replacement along with part replacements.	High	High
Automatic Screen Filters	Down to 10 microns	Used in removal of particles ≥10 microns (both low and high density). Budget friendly.	Contains moving parts that may require maintenance and replacement.	Low	Low

Micro Filtration	Down to 0.1 microns	Used in extremely fine filtration (at times used as a temporary solution).	Consumable type products can be costly over time.	None	Low
High Efficiency Media Filter	Nominal 0.5 microns (submicron performance)	Used in removal of fine particles ≥0.5 microns. High efficiency filtration, requiring a small footprint (when compared to traditional sand filters).	Media replacement (every 5-7 years).	Medium	Low

Centrifugal Separators

Centrifugal separators (or hydrocyclones) are primarily selected due to the technology being the least expensive in terms of equipment costs. The separator utilizes centrifugal forces, spinning the water to separate the heavier particulate from the water.

Centrifugal separators can remove up to 90 percent of the particles that have a specific gravity equal to sand and are larger than 70 micron[1]. Unfortunately, particles that are organic or lighter than water, or particles smaller than 70 microns, will not be removed.

Centrifugal separators are cleaned by purging the particle collection chamber or allowing a continuous flow of water from the collection chamber to a nearby drain. Centrifugal separators are often used in conjunction with a filtration system, one that is capable of removing the smaller and lighter particles. The technology's footprint and compact design makes it appealing for retrofit projects. The simplicity of the technology, not trapping particles that clog or damage its components, yields little maintenance requirements.

Traditional Sand Filters

Traditional sand (or media) filters direct cooling water onto the surface of the media bed (one or multiple layers of media). As the cooling water passes through the media, particles are captured within the layers of the media bed. The water than moves downward, passing into a drain at the bottom of the filter tank and discharging through an outlet pipe. Such filters have the capacity to remove organic particulate that are ≥10 microns. The system's performance in removing fine particles highly depends in the type of media(s) being used within the filter bed.

It is important to note that backwashing heavy particles (such as dirt, sand or calcium carbonate) collected from the tower without losing some of the media is nearly impossible. Periodic replacement of the media is one of the maintenance requirements of traditional sand media filtration systems.

These units require a relatively large footprint, making it a challenging solution for retrofit projects where space may be in short supply. With a larger footprint the concern for higher construction and infrastructure costs can quickly become a burden. The size of these traditional sand filters also yield a second concern, water usage. It can be disputed that with time, the backwash cycles will be reduced and water usage will be decreased, although these systems are still the most daunting in water waste when compared to the other side stream filtration technologies.

Automatic Screen Filters

(use VAF picture)

Water passes through the weave-wire screen filtering element with solid particles being captured by the screen. The screen-filtering element acts as a barrier, removing all particulate (both organic and inorganic) down to 10 microns. Automatic self-cleaning screen filters are gaining traction in the industry, becoming the filter technology of choice for cooling tower filtration applications requiring removal of particles 10 microns and larger. During the self-cleaning process, this technology yields the least flushing discharge. Screen filters also provide uninterrupted filtration during the cleaning process, thereby requiring only a single filter for continuous 24/7 filtration.

Cartridges & Bag Filters

Where demanding or specialized fine filtration is required, micro filtration systems are available. These systems can achieve removal of both organic and inorganic particles down to 0.1 microns without requiring a backwash cycle. They are also considered to be one of the most flexible side stream solutions, adjusting the level of micron filtration as needed. However, these consumables can become costly with time. The cartridges and bags require monitoring and manual replacement. When frequent replacement is necessary, such systems require a pre-filter to be placed in front of the bag/cartridge. Doing so will aid in removing the larger particulate, reducing the total suspended solids (TSS), ultimately maximizing the life of the micro filtration system.

High Efficiency Media Filters

(use Vortisand picture)

High efficiency media filters are similar to traditional sand filters in that sand is used as the filtration media. However, the size, shape and weight of the sand (microsand) used in high efficiency systems allow for improved filtration efficiencies. The injectors also differ; they generate cross-flow patterns that sweep the surface of the media. This sweeping motion causes a portion of the water to flow parallel to the top layer of the media, allowing for submicron filtration performance while preventing media fouling at the surface and water channeling through the media.

Contaminants trapped upon and within the microsand media (depth filtration) are removed using an automatic backwash cycle. The system's backwash cycle requires less flow and a shorter duration than traditional sand or multi-media filters. The result is a technology that removes particles down to submicron levels at 4 to 5 times the hydraulic flow rate of traditional media filters, while requiring up to

50% less water for backwash. The nature of the microsand and cross-flow technology has aided in the creation of a system that occupies and weighs up to 80% less than traditional media filters. The technology is now available for horizontally stacked vessels, doubling your filtration capacity within the same footprint.

It is important to keep in mind that as much as this technology can deliver submicron filtration performance, it requires a higher capital equipment cost when comparing to other side stream solutions.

The Cooling Water Challenge

During the cooling process, the cooling water absorbs large volumes of airborne particulate - acting as an air scrubber filtering the surrounding air. With time, these fine particles can build up and settle within the system, adversely affecting cooling performance while lowering the life of wetted sub-components. Typically, ***85% of suspended solids in cooling water and hot water loops are smaller than 5 microns in size***[2]. Scientific studies have shown that these fine particles (5 microns and less) tend to be the adherent contaminants causing fouling of the cooling tower water, chilled water and heat exchangers, thereby reducing cooling system efficiency[3].

Which Side Stream Filtration Technology Do I Choose?

A filtration system can be designed to meet any level of desired filtration quality. The most important prerequisite in specifying the right filtration system is to define your requirements for the process.

Design features to look for include:

- The ability to remove organic and inorganic suspended particles.
- Uninterrupted filtration.
- Water loss considerations from back wash process.
- Lower maintenance and operational costs.
- Filtration performance & particle removal rate for maximum process or cooling efficiency.

Most importantly, purchase the level of filtration that will provide the greatest return on your investment. Assessing your need for a side stream filtration system will yield a large ROI for years to come. ***Protect your facility, your investments and your bottom line!***

References

[1] Based on published separator manufacturers' statistics.

[2] Based on multiple laser particle distribution tests completed in-house

[3] U.S. Department of Energy (2011). Cooling Towers: Understanding Key Components of Cooling Towers and How to Improve Water Efficiency. DOES/PNNL-SA75820

[4] A Low-Cost, Safe, Effective Halogen Disinfectant for Cooling Towers, by Susan B.

Rivera, PhD, Rodney Herrington, P.E., Cooling Technology Institute Paper No. TP08-21

[5] Cooling Tower Filtration Efficiencies and Green Building Initiatives, by Glenn Dobbs, VAF Filtration Systems, 2010