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SEPARATING FILTER FACT & FICTION

Selecting the most appropriate filtration system for your application can help increase cooling tower efficiency and reduce the environmental footprint.

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Because it removes sediment and organic particles from cooling tower water, a good filtration system is an important factor in improving tower efficiency. Proper filtration also can improve a cooling system's environmental footprint — a measure of ecological friendliness that takes into account energy use, water efficiency, chemical demand, the volume of consumables disposed of, and even the physical space occupied by the system.

The open design and large volumes of air and water flowing in cooling towers make them highly effective collectors of particles and debris from the ambient environment. Rusting or scaling pipes, crumbling heat exchanger media, minerals and organic contaminants in the water, and water treatment chemicals also can contribute large volumes of sediment and biological growth to the cooling tower environment.

The effects can be alarming. Thermal resistance can significantly decrease heat transfer efficiency, which in turn increases pumping costs. In fact, according to the *Carrier System Design Manual*, a fouling layer of just 0.001" on a condenser surface can increase overall energy consumption by 10 percent.

In addition, blocked cooling tower packing or plugged spray nozzles decrease the surface area used for heat transfer. Sediment can plug pipes, valves, pumps, screens and filter cartridges or bags. It can cause significant abrasion of pumps and seals and reduce the life expectancy of air compressor water jackets, condenser tubes and heat exchangers. Sediment also speeds corrosion, both directly (by contacting metal components) and indirectly (by shielding heat exchangers, piping and basin walls from corrosion inhibitors and oxidants).

Suspended particles also increase chemical demand, tying up corrosion inhibitors, polymers and anti-scale chemicals while increasing the demand for biocides. Biocides represent the highest cost for a conventional water treatment system, and filtering out suspended solids can result in a 20 percent savings in biocide costs.

With all the damage sediment can cause, it is easy to see how tiny particles can quickly become a huge problem.

Filtration Options

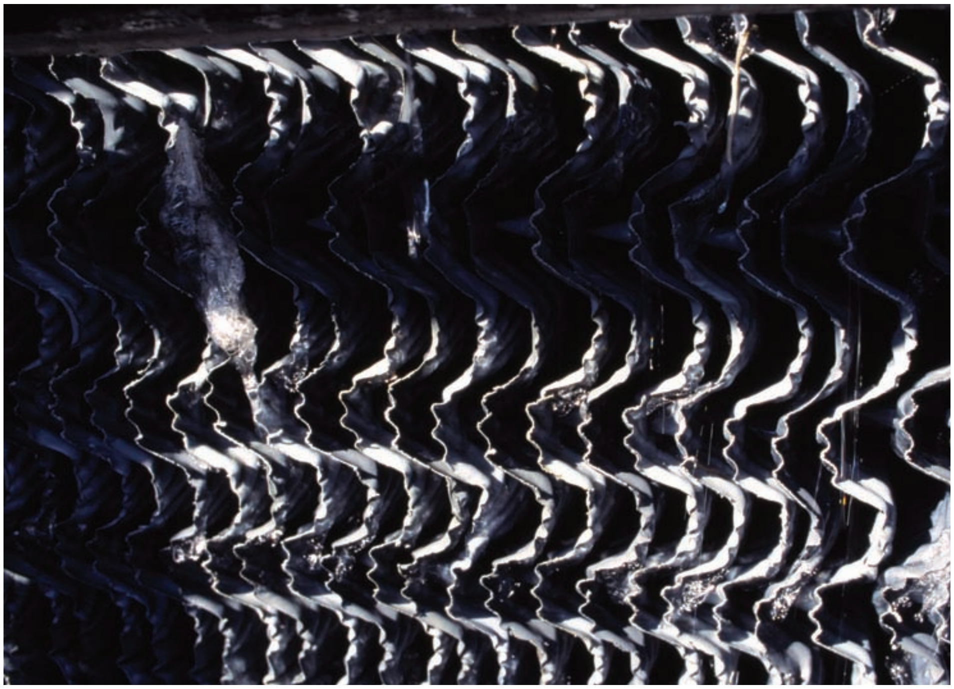
The degree of filtration needed to adequately protect cooling tower components depends largely on how water is managed in the system — for instance, whether nozzles are used to spray the water onto a cooling surface — and the types of particles most commonly found in the water.

If nozzles are used, they provide a helpful focus for determining the necessary degree of filtration. Where hard inorganic particles such as sand are the principal contaminant in the water, choose a degree of filtration between one-fifth and one-third of the orifice size. That will protect against clogging orifices with single particles and safeguard against particles bridging across nozzle orifices. Stickier organic particles tend to build up over time, so filtration degree should be finer — one-tenth to one-eighth the diameter of the orifice tends to work well.

A range of filtration technologies are employed in cooling tower applications. Though all are helpful, choosing carefully can save money and headaches in the long run.

Most cooling towers have large screens to filter out big debris such as leaves and twigs. However, straining out debris is just a start. Even after straining, several pounds of sediment per ton of cooling water in the system can still be present.

Hydrocyclones, which use centrifugal force to separate heavy particles from the water stream,



Rusting or scaling pipes, crumbling heat exchanger media, minerals and organic contaminants in the water, and water treatment chemicals can contribute large volumes of sediment and biological growth to the cooling tower environment. Automatic self-cleaning screen filters can reduce the environmental footprint of a cooling tower by minimizing energy consumption, backflush water, chemical use and physical infrastructure needs.

are popular in cooling tower applications. Though they are extremely effective at removing sediments with high specific gravity, hydrocyclones are less effective at separating out lighter particles. In some applications, that can be a notable shortcoming.

Sand media filters are highly effective at removing very small particles, whether hard or deformable. The technology has been in use since the early 1800s and has proven itself widely. However, sand media filters have a large footprint, and backflushing them requires an interruption in the filtering process as well as a notable amount of clean water.

Bag or cartridge filters are highly effective, but replacing cartridges or bags demands labor time and effort and can create issues surrounding solid waste disposal. Prompt maintenance is a must. As they do their jobs, cartridges or bags create a pressure drop on the system that can increase from an insignificant 2 psi (0.14 bar) with a new cartridge to as high as 30 psi (2 bar) when the cartridge is dirty.

Automatic self-cleaning screen filters are effective, compact and nearly maintenance-free. When the pressure differential between the inside and outside of the screen reaches a preset level such as 7 psi (0.5 bar), a valve opens to create an outlet at atmospheric pressure. The differential between the internal pressure and atmospheric pressure draws water and filter cake through an array of small, focused backflush nozzles and out of the system. The nozzles spiral around the screen, cleaning it without interrupting filtration.

Sidestream or Inline?

Specifying a filtration system before the build phase of a cooling tower allows many operations to install inline filtration between the supply pump and the heat exchangers or chillers. This allows the processor to filter the entire volume of water and provide optimal protection to heat exchange surfaces, piping and nozzles.

However, existing cooling towers need protection too. Retrofit applications often call for a sidestream filtration system to be installed. Sidestream systems filter a portion of the tower's total flow at one time. Using the system's main pumps to move water to the filtration system is very efficient. After filtration, the clean water can be reintroduced to the regular flow through a booster pump or routed to the tower

Open to the environment, cooling towers are highly efficient collectors of particles and debris.

basin with no additional power.

The capacity of sidestream systems can range from 5 percent to 20 percent. Ideally, sidestream systems can be sized to handle the entire turnover of the cooling tower's water — including the capacity of basin, pumps, chillers/exchangers and piping — once an hour. From a cost standpoint, however, a one-hour turnover may not be feasible for very large systems.

Smaller Environmental Footprint

Today, every industrial and commercial — and even residential — facility is under pressure to conserve energy, conserve water, reduce the amount of waste it generates, and minimize the volume of chemicals it uses: in short, to shrink its environmental footprint.

In industrial applications, good filtration can help reduce the chemical needs of a cooling tower system. That immediately translates into lower costs, less chance for worker exposure, easier water management and better public relations.

Properly selecting and managing a filtration system also can reduce water consumption. Cleaner water requires fewer blowdowns from the basin, which in turn means less water and chemicals go down the drain. And, more efficient filters require less backflush water. A higher demand for backflush water can represent a burden on local wastewater treatment facilities and a significant cost to the plant or the local community.

Different types of filters require different amounts and types of backflush water flow. Sand media filters can require three to four times more backflush water than automatic self-cleaning screen filters. Also, sand media systems must be backflushed with clean water, which may be the most "expensive" water in the cooling tower system if it has been filtered and treated with chemicals.

As industrial engineers seek approaches to doing a more effective job with a smaller environmental footprint, tools such as cooling tower filtration systems will become increasingly important. **PC**

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Web Exclusive

Filtering even a percentage of the total flow can yield a significant return on investment.

Filtering even a percentage of the total flow can yield significant return on investment (ROI). A power-generating company installed filtration to handle 2 percent of its 150,000 gal/min flow. Its engineering staff determined that it would save $818,000 per year, including:

* $30,000 savings in tower basin and condenser tube cleaning costs.
* $170,000 in cooling water chemical treatment costs.
* $306,000 in improved condenser efficiency.
* $312,000 in high-efficiency fill costs.

One high-tech customer who replaced a bag filter with an automatic self-cleaning screen filter system at a high-tech fabrication facility says labor costs dropped dramatically after it was installed. With the combination hydrocyclone and bag filter system, his team had spent one to two hours a day replacing consumables and frequently had to clean out pumps, cooling tower pans and chillers. Now tower clean-out is performed quarterly, and every couple of years he opens up his screen filter system to replace seals and pressure-wash the screen and housing.

"We figured our ROI would be under 18 months, and it turned out to be around 15 months," he says. "That's a good ROI. We ended up buying two more here and two bigger ones for the towers across the street."

Other customers have noted similar savings. A Midwestern steel mill installed an automatic self-cleaning screen filter and saw manual basket screen cleaning — which had to be performed as frequently as every three hours during stormy weather — drop to zero. An aluminum casting operation extended the interval on its manual chilling mold clean-outs to 20 days, a vast improvement over the three-day cycle its operations crew had maintained before they installed a self-cleaning screen system.

"Whatever you're doing, you have to be filtering out more material than the ambient air is introducing," says Tom Hamilton of Power Products in Vancouver, Wash. "We've found 10 percent to be very effective. You're eventually going to get to a stable state."

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