# FILTERING THE COST

Different water filtration systems each offer differing benefits and associated costs. Understanding the differences in these technologies is necessary for proper selection.

*The days of discharging large amounts of wastewater from cooling-tower systems to the sewer are nearing an end. However, as water filtration systems become more efficient, the economics of water and energy-efficiency bite.*

We are all aware of the benefits of keeping cooling-tower systems clean.

A clean, open recirculation cooling water system maintains public safety by managing the risk of microbial growth, including Legionella. It also assists in maintaining heat-transfer efficiency, reduces maintenance, and enhances the effectiveness of any water treatment program.

But open systems are prone to all manner of fouling from airborne and waterborne contaminants, as well as those contaminants associated with a process.

Air contains dust, dirt, organic matter, insects, microbiological organisms and gasses. Make-up water can contain a variety of dissolved salts, suspended solids and microbiological organisms.

Systems can also produce suspended solids from within, due to corrosion, scale and microbiological growth.

These contaminants can be removed from the cooling-tower system using filtration. This can also reduce water consumption, extend the life of the system and system components, as well as reduce maintenance and its associated costs.

Separators, media filters, automatic screen filters and cartridge/membrane systems all offer an effective way of removing material from the circulating water. However, each of these technologies offer differing benefits and associated costs.

> “Filtering the cooling-tower water minimises the need for manual cleanings and the associated costs and system downtime.”

According to Hydrochem’s senior project manager and VAF filtration product manager Roy McDougall, understanding the differences in these technologies is necessary for proper selection.

He says the selection of a filtration system will depend on the quality of the make-up water being added to the system, the type of contaminants getting into and/or being generated within the system, and the contaminants already existing in the system.

Additionally, the operational duty of the system, the type of water treatment being applied, and the cycles of concentration at which the system is being operated should all be considered.


## DESIGN FEATURES

HydroChem's Roy McDougall suggests looking for the following design features in a cooling-tower water-filtration system:

- The ability to remove both organic and inorganic suspended solid particles
- Uninterrupted filtration during the flush or screen-cleaning process
- Flush-flow rates in the range of 5 to 10 per cent of the filter's total flow rate to minimise the loss of treatment chemicals and make-up water requirements
- Short cleaning cycles
- Simplicity in design – fewer moving parts and simpler controls require less maintenance.

"Selection of appropriate filtration systems should be made in conjunction with a specialist, and/or a filtration system supplier or manufacturer," McDougall says.

## THROUGH THE FILTER

Filtering cooling-tower water is likely to provide several significant benefits that will provide a significant return on investment.

McDougall says the use of an efficient filtration system will improve cooling-system efficiencies by reducing the "fouling factor", which can otherwise increase energy consumption.

"It has been shown that 0.023mm of fouling equates to a 10 per cent reduction in cooling efficiencies," he says, referring to the ASHRAE 2000 Systems and Equipment Handbook.

"Solid contaminants can also clog small-spray nozzle orifices, causing poor distribution of water throughout the cooling-water distribution system. Filtration minimises deposits on heat-transfer surfaces, prevents heat-exchanger clogging and maintains efficient cooling-water distribution."

Filtering the cooling-tower water minimises the need for manual cleanings and the associated costs and system downtime.

"In most cases, an efficient water-filtration system can reduce system downtime by more than 80 per cent," he says.

The life of the entire cooling-tower system can also be extended by preventing solid contaminants from building up in the system. The presence of solid contaminants reduces the ability of treatment chemicals such as corrosion inhibitors or oxidisers and biocides to reach the surface of the cooling tower basin, pipe-work, and heat-transfer vessels.

This leads to a reduction in chemical treatment and associated costs.

"A layer of contaminants in the cooling-tower system provides an excellent environment for corrosion, bacteria, and algae growth," says McDougall. "Also, suspended solid contaminants can reduce the beneficial effects of treatment chemicals and can make additional chemical treatments necessary."

Filtering also prevents the contribution by solid contaminants to bacteria growth such as Legionella pneumophila and algae. This further minimises the additional need for chemical use.

> "The most important prerequisite in specifying a filtration system is to define the requirements of the cooling tower in which the system will be used, as well as the quality of the water to be filtered."

## FILTER SELECTION

In open-loop water-circulation systems, such as those used in cooling towers, filtration systems can be sized to filter around 5 to 10 per cent of the full stream.

This set-up is commonly known as side-stream filtration.

According to McDougall, with this amount of the full stream filtered, the water is cleaned and its particle-load condition stabilises in a short amount of time – typically less than two or three days.

"In areas where debris is more prevalent, the side-stream amount can be increased to handle the higher particulate load," he says. "But in severe cases, a full-stream system can also be implemented."

A number of filtration technologies are currently available in the Australian market.

These include centrifugal separators, sand media filters, micro-filtration systems and self-cleaning screen filters.

All have their pros and cons.

For instance, centrifugal separators can remove up to 90 per cent of particles that have a specific gravity greater than water and are larger than 70 microns. With that being said, organic particles and those lighter than water or smaller than 70 microns are unlikely to be removed in a single pass. To be removed, those particles must remain suspended for longer periods of time.

> More recently, automatic self-cleaning screen filters have become the filter technology of choice for cooling-tower applications, as they remove all particles down to the micron rating of the filter.

For this reason, centrifugal separators are often used in concert with other filtration technologies to remove the remaining, finer and lighter particles that have passed through the separator.

While sand-media filters can remove particles 10 microns or smaller, and are excellent for removing organic debris, they require a relatively large footprint and back-flushing. This not only takes the system offline for minutes at a time, but the process to remove heavy particles often results in the loss of a significant volume of water, as well as the loss of filtration media.

Where micro-filtration is required for specialised cooling systems, cartridge, bag or membrane systems can remove both organic and inorganic particles as small as 0.5 microns without requiring back-flushing.

According to McDougall, such systems can be expensive because the cartridges, bags or membrane systems used might foul frequently and require replacement.

## THE USUAL SUSPECTS

There are three primary sources responsible for most common cooling tower contaminants:

### 1. Airborne

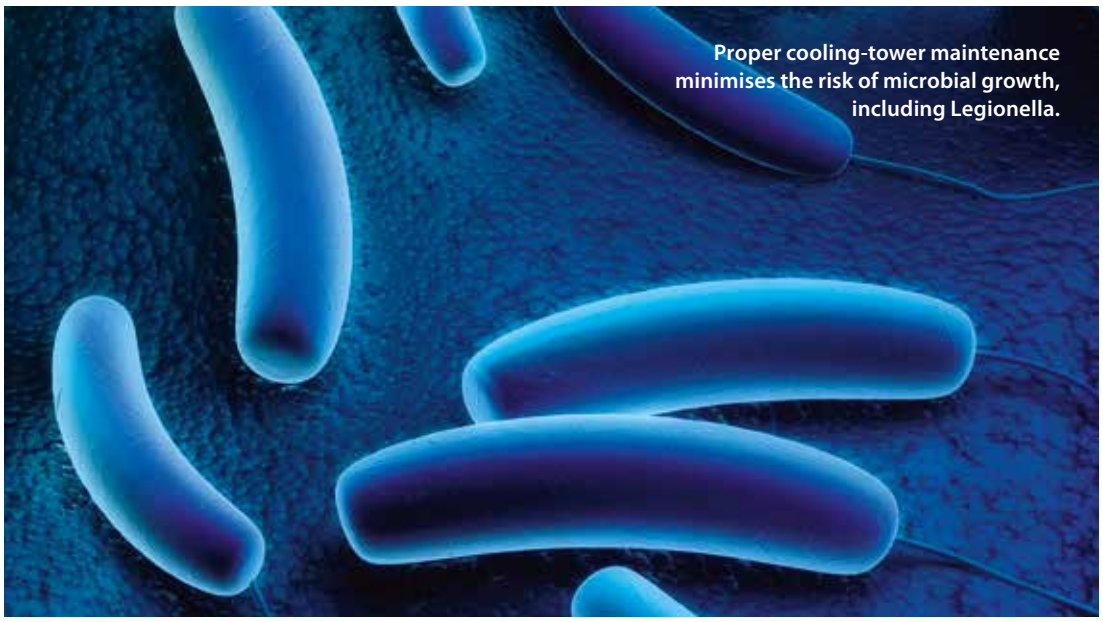
Cooling towers make excellent air scrubbers. As relatively high volumes of air pass through cooling towers, most of the contaminants in the air will end up in the cooling-tower basin. These include dirt, windblown sand, soot, and all manner of organic debris.

### 2. Circulation water

The water circulated through the cooling-tower system can also be responsible for contaminants building up in the system. Calcium-carbonate scale that forms in the system will flake off and enter the circulation water, while treatment chemical residue and algae can also build up.

### 3. Make-up water

Depending on the source and water quality, the make-up water used by a cooling-tower system can also contribute to contaminant build-up.



**Proper cooling-tower maintenance minimises the risk of microbial growth, including Legionella.**

"Where frequent replacement is required, these types of filters may require a pre-filter to be placed in front of the bag, cartridge or membrane to remove the larger particulate and reduce the total suspended solids (TSS), thereby maximising the life of these technologies," he says.

More recently, automatic self-cleaning screen filters have become the filter technology of choice for cooling-tower applications, because they remove all particles down to the micron rating of the filter.

These filters result in the least flushing discharge (wastewater) during the self-cleaning process, which some are able to undertake without disruption to the system.

"Some automatic self-cleaning screen filter technologies use only a few gallons of water during each flushing cycle," says McDougall.

"With the lower flush-volume required to clean the screen, it is much easier to show that none of the flush water is waste, since it is a small portion of blow-down requirements."

## SYSTEM DESIGN

As airborne contaminants and suspended solids in the circulating water tend to settle out in a cold-water basin, this is usually the most effective location for the filtration system to be installed.

Like a side-stream arrangement, water is removed from and returned to the cold-water basin via the filter.

Some basins can incorporate sump agitation to remove settled solids, while water jets or eductor nozzles can be employed to create underwater currents to direct solids toward the drain or filter-suction points.

So which filter system is right for your application?

"A filtration system can be designed to meet any level of filtration quality desired," McDougall says.

He says the most important prerequisite in specifying a filtration system is to define the requirements of the cooling tower in which the system will be used, as well as the quality of the water to be filtered.

"Most importantly, purchase the level of filtration that will achieve the highest ROI," he says. "And reduce the total suspended solids only to the desired, cost-effective level."

"Don't over filter – you're not going to drink it." ■

**Source:** *The ROI of Cooling Tower Filtration* by Roy McDougall, HydroChem