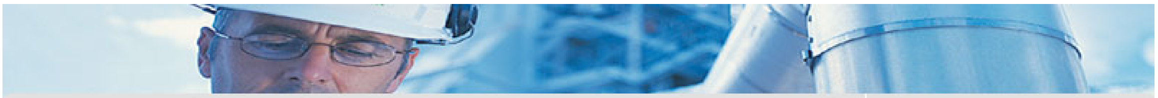


TECH TALK

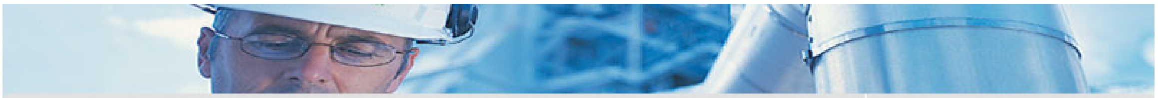
The Importance of Side Stream Filtration in Water and Energy Conservation

By Kenn Latzer, Process Efficiency Products, Inc

Building owners and those responsible for the design, operation and maintenance of a facility and its equipment often overlook the impact of cooling tower operation on their profit and loss picture. It is not unusual for a large facility to spend hundreds of thousands of dollars in energy costs for cooling, to which must be added additional costs of equipment maintenance and downtime losses. Even a small increase in efficiency and reduced maintenance requirements can result in savings of tens of thousands of dollars a year. Improving the quality of the water in these systems is the simplest and most cost effective method of obtaining these savings.

Several aspects of water quality can affect cooling system performance. Total dissolved solids (TDS), pH, alkalinity, hardness and other chemical aspects of water quality can be predicted and controlled by comparing a chemical analysis of makeup water to evaporation potential and calculating expected conditions. However, there is one variable that defies easy prediction…the amount of particles (Total Suspended Solids) in the water. The air that is drawn through the fill of a cooling tower inevitably contains particles of dust, soil, soot, organic debris and numerous other materials. These particles are effectively scrubbed from the air by the cooling tower and concentrated in the water. Particle concentrations vary and are influenced by constantly changing factors such as wind direction, amount and type of traffic, and the activity of neighbors (e.g. construction, plant operation cycles, etc.), among others. It is not unusual for air over a large city to have upwards of 100,000 particles in each cubic centimeter of air. Clive Broadbent's quote in the 1992 ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) report states, "a typical 200 ton cooling tower in a season, may assimilate upwards of 600 pounds of particulate matter from airborne dust and make-up water supply" (ASHRAE Handbook, 1996).

In addition, the system itself produces particles. These include corrosion products, mineral precipitates (e.g. iron oxides, hardness salts), microbiological colonies, aggregates of organic chemicals and many others.



Contamination by dissolved and particulate materials leaking from the process side of heat exchange equipment adds to the process by precipitating insoluble chemical products, providing nutrients for accelerated biological growth, and accelerating corrosion and the formation of corrosion products.

The particulates in cooling water, when bound together by precipitation of scale-forming minerals, result in a greatly increased volume of scale and a thicker scale layer. Similarly, particles bound together by development of a biological foul layer also increase the foul volume and layer thickness. These layers decrease heat transfer efficiency, reduce flow rate across heat exchange surfaces and encourages corrosion, resulting in additional fouling. Slower flow allows more particles to settle, amplifying the problem and further reducing efficiency.

Benefits of Clean Water

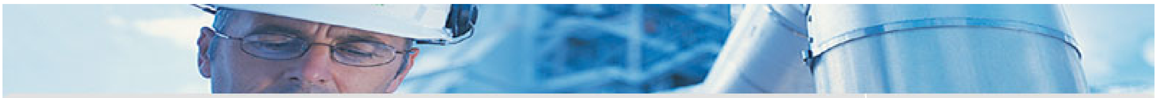
Of the numerous water quality parameters that may affect performance, suspended solids are the most common and serious culprit. Therefore, the benefits of removing particles from the system are numerous. They include:

1. Reduced Energy Consumption

A layer of foul or scale measuring 1/1000 inch thick can reduce heat transfer to increase energy costs by as much as 10 percent. The formula listed below can be used to calculate the energy cost per year for an air-conditioning system:
A\C ton x kw/ton x load factor x hours of operation/yr x cost/kwh = Energy Costs/Year

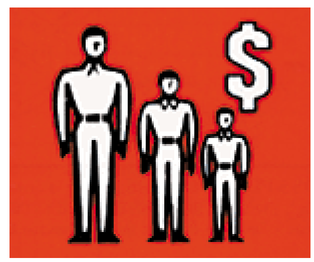
For example:
400 ton A\C x 0.65kw/ton x 0.7 load factor x 2500 operating hours x $0.07/ kwh = $31,850 energy cost for one year

Consider the same 400 ton chiller operating 2500 hours a year at $0.07/kwh with a foul layer of 1/1000 inch thick will result in $3,185 increased energy costs per year. A 10 percent increase!



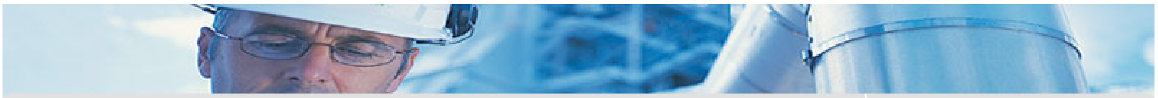
2. Improved Chemical Performance Particles consume chemicals used to prevent scaling and corrosion. As a result, dirty water requires more chemicals and receives less effective treatment than clean water. Biocides are also consumed by particles. In addition, particles provide habitat and nutrients that bacteria and algae need to thrive. A filtration system that removes suspended particles allows the water treatment program to operate at maximum effectiveness with minimum chemical use. The result is enhanced water quality at lower chemical costs.

3. Lower Maintenance Cost
Traditional methods of cleaning a cooling tower include draining the tower and shoveling sediment from the sump. This incurs costs for downtime, labor, lost water and chemicals. The savings obtained by doing this mechanically with a filtration system translates to substantial savings and is an added bonus in recovering the cost of a filtration system.



4. Improved Productivity and Less Downtime
Fouling a cooling system can slow production. Five seconds added to a plastic mold cooling rate can mean 25 fewer parts per day, translating to less profit per machine. This is compounded by the number of molding machines a plant may have, which can significantly impact profits. In some cases, a water cleaning system may cost as little as a single day of downtime.

A successful water treatment program will include steps to remove or reduce the volume of particles that inevitably collect in any cooling system. Water inspection at the cooling tower is easily viewed without system shutdown and should be considered an indicator of total system condition and cleanliness. Place your hand in the basin, check for dirt and observe if the fill is clean. Any accumulation of dirt is a sign of future problems.



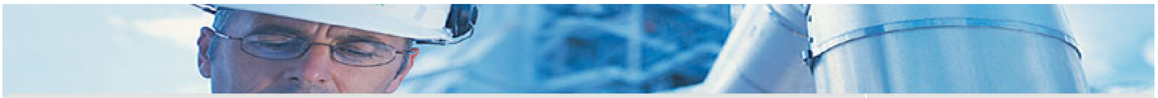
The *LEGIONELLA* Problem

Today, anyone with a cooling tower must consider the growing *Legionella* problem. ASHRAE Guideline 12-2000 presents basic treatment recommendations for control and prevention of *Legionella* in cooling towers, stating that a principal key to success in *Legionella* control is system cleanliness. The September 2000 issue of the ASHRAE Journal (pages 44-49) states, "Conditions favorable for amplification of *Legionella* growth includes water temperature of 77°F to 108°F and presence of scale, sediment and biofilm… generally *Legionella* thrives in diverse complex microbial communities because they require nutrients and protection from the environment." More simply, maintaining low particle levels reduces the habitat surfaces and nutrients required for *Legionella* growth.

This should be coupled with an appropriate biocidal program of proven effectiveness for control of *Legionella*. It is recommended that a water treatment specialist oversee the treatment program. Further, to protect yourself from legal exposure should someone contract Legionellosis, it is recommended that your specifications require good record keeping on the operation and maintenance of the system. These records should include manufacturer's operating and maintenance manuals; description of the water treatment program; dates and data of all inspections and maintenance; material safety data sheets for all chemicals used; dates of any repairs; records of system water volume; names and duties of person(s) responsible for system start-up, operation and shut down. Assuming steps have been taken to keep your system clean, and that you are employing an appropriate biocidal program, these records will demonstrate that due diligence has been performed. All that can be done to protect the public from contracting Legionellosis from the cooling tower mist has been taken.

Filtration Selection Required for Clean Water

Control of suspended particles is easily achieved by filtration. This is not a new idea - your body uses kidneys to remove impurities. In fact, the human body is far more tolerant of many "impurities" contained in our water than are many industrial applications that use water in the manufacturing process (i.e., your car has an oil filter to protect your engine). Hence, filtration of cooling tower water is just as important. Many think that filtration must treat the full system flow. However, like your car's oil filter that treats a small portion of the oil at time, side stream filtration is most practical and effective in cooling towers. For example, a 400-ton cooling tower has a flow rate of 1200 gpm. A filter large enough to treat this entire flow would be 108 feet in diameter and would require it's own building. However, it has been found that a 5% side stream flow through a filter is all that is needed to control suspended solids.



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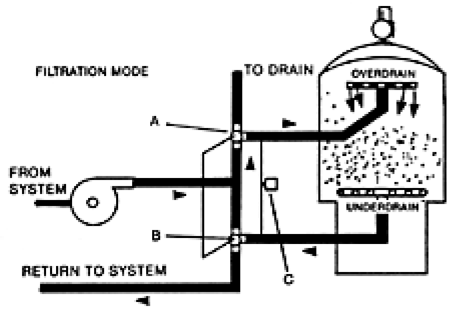
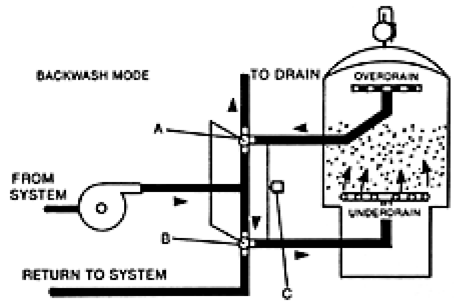




Five percent of 1200 gpm is 60 gpm, which requires a 24-inch filter with a flow rate of 63 gpm.

Removal of particle as small as 5 to 10 microns is required for effective Legionella control, since these small particles constitute the bulk of particulate surface area for bacterial colonization and are most easily incorporated in foul and scale. Many cooling tower operators use centrifugal separators to reduce particle load, but these only remove relatively large (70 microns) or dense (sp. gr. 2.6) particles.

In the September 2000 issue of Chemical Engineering, W.C. Meyer states, "Centrifugal separators do not remove very small or low density particles and are, therefore, not appropriate for this purpose."

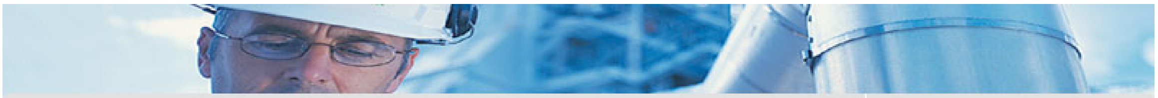
There are several filtration technologies that can be used to accomplish this goal. They include:

Cartridge filters
Bag filters
Permanent Media filters

Cartridge and bag filters are relatively inexpensive, but their consumable filter elements require regular replacement. The cost of cartridges and bags and the associated labor required for their continuous replacement results in high operating costs that override any savings made on the initial purchase. In comparison, permanent media filters have a higher initial cost but much lower operating costs that make them more economical.

Filtration Operations

Water entering a permanent media filter is evenly distributed over the sand bed, achieving full penetration. As the particles are removed they coat the surface of the media bed creating a surface layer or "Schmutz Deck" of particles that increase the effectiveness in removing the finer particles not easily filtered by bag or cartridge filters. In other words, the dirt removed becomes the filter media for removal of the next particle. When the permanent media becomes clogged, it is regenerated by backwashing the filter bed.



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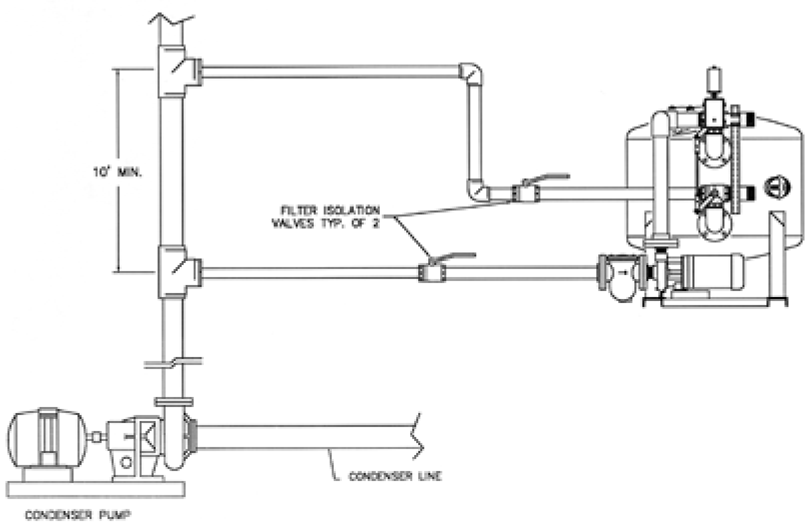
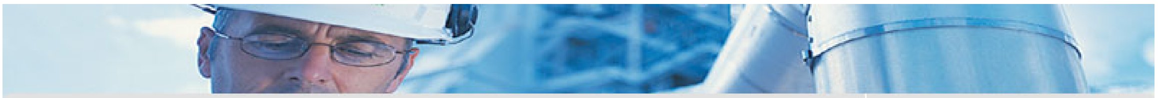
This system requires little or no personal attention and can use the same media for years, producing substantial savings in material and labor costs when compared to other disposable filter technologies. Studies have shown that the average permanent media filter will pay for itself in less than two years.

Side stream permanent media filters can be installed in two ways. An in-line filter taps the condenser circulation line where water is drawn off, filtered, and the clean water returned to the circulation line. Filter input and return lines should be at least 10 feet apart to avoid registering the same water. Sump/basin sidesteam filtration removes, filters and returns clean water directly to the tower sump. This is the system of choice, since it allows use of sweeper jets to direct sediment to the filter inlet to keep the basin free from debris. Today, all three major manufacturers of cooling towers [BAC, Marley, Evapco] offer sweeper jets as a factory option.

SIDESTREAM FILTER INSTALLATION





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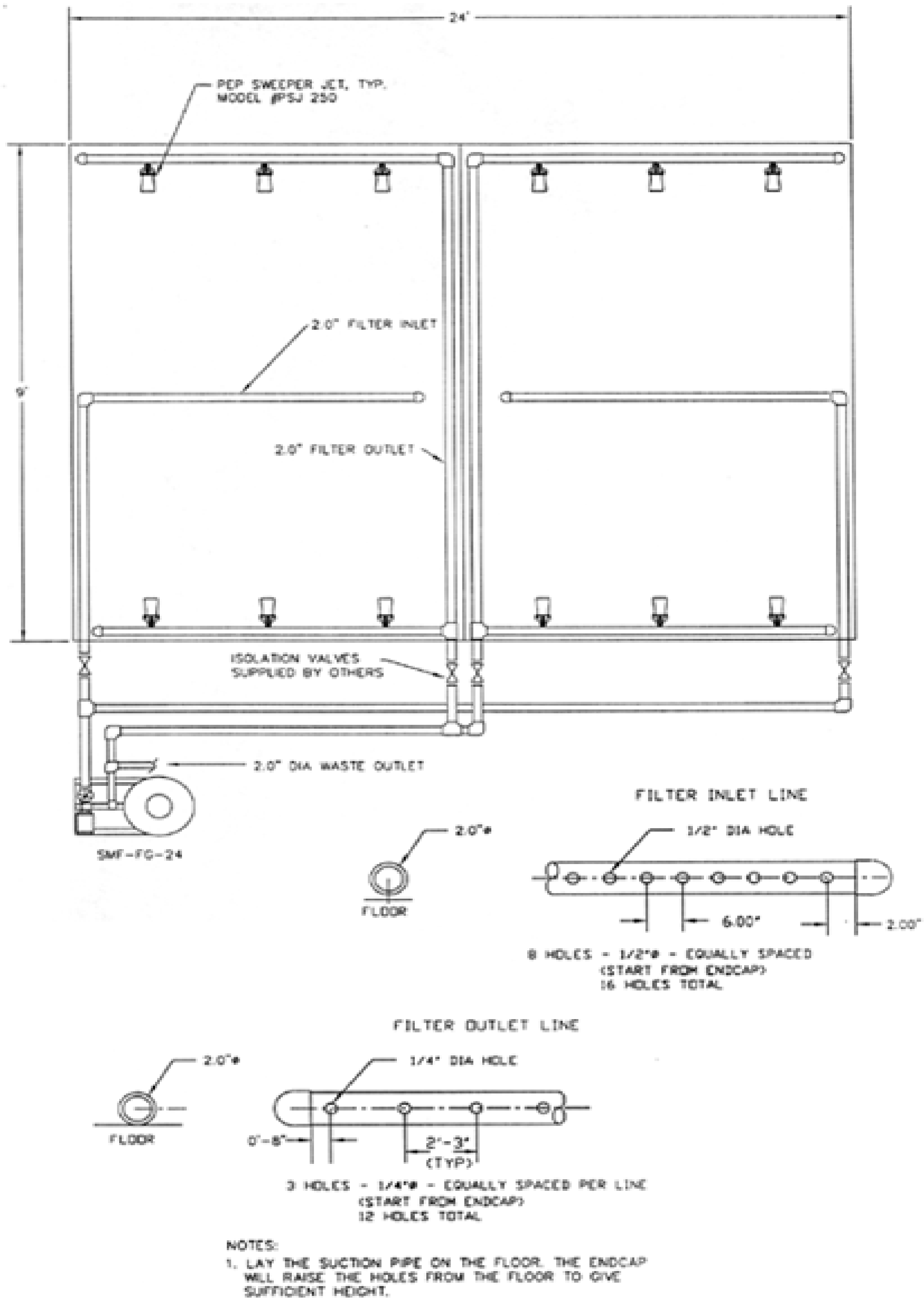

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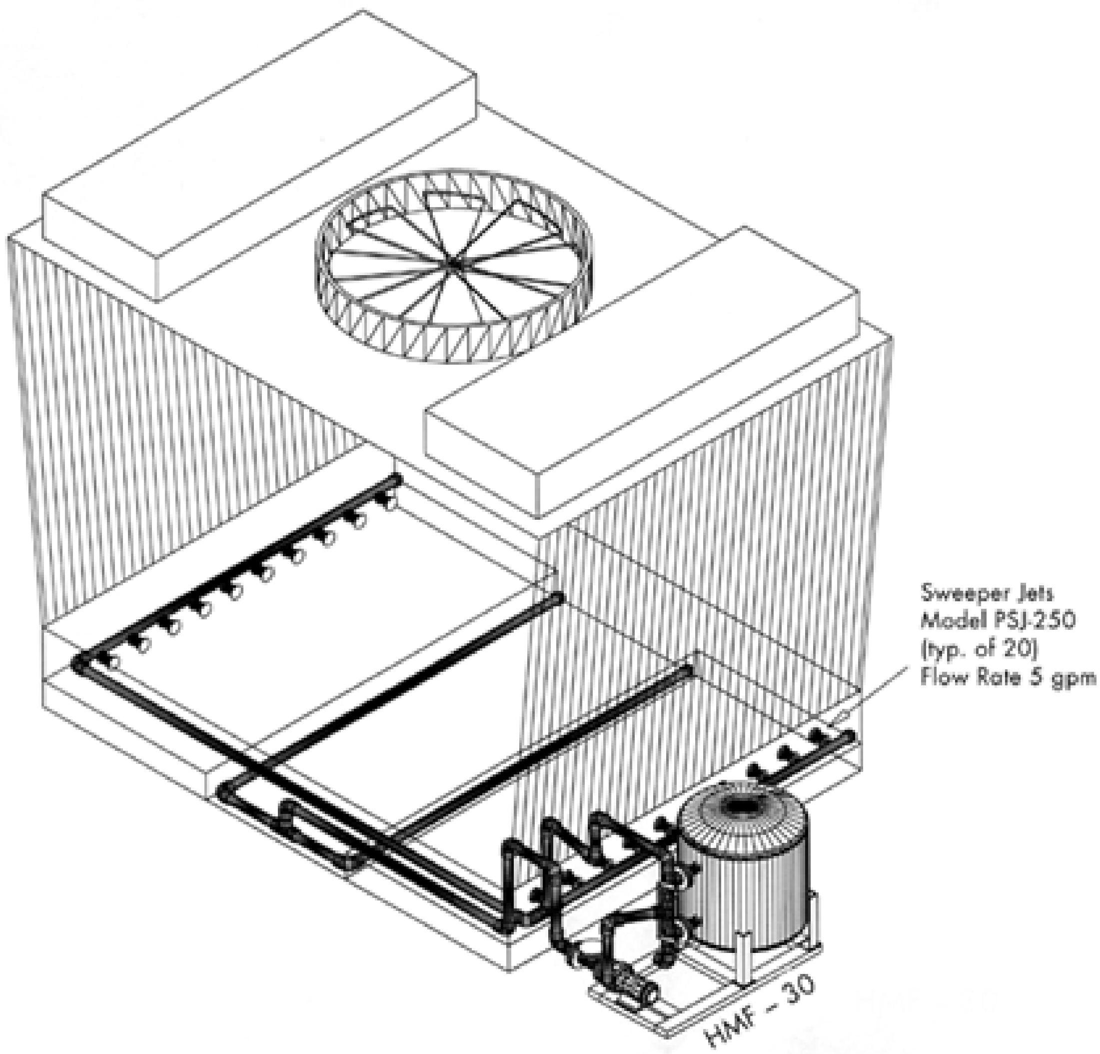

Summary

As suggested by ASHRAE and confirmed by numerous industry articles, there is one simple way to maximize the efficiency of any cooling system. Obtain the best economic return on your cooling system investment and protect against spreading disease by keeping your water clean.