ZGF TECH BRIEF
COOLING WATER FILTRATION
THE BEST INVESTMENT OFTEN NOT MADE!

The Most Advanced, Automatic, Non-Disposable Liquid Filtration System

ZERO GRAVITY FILTERS

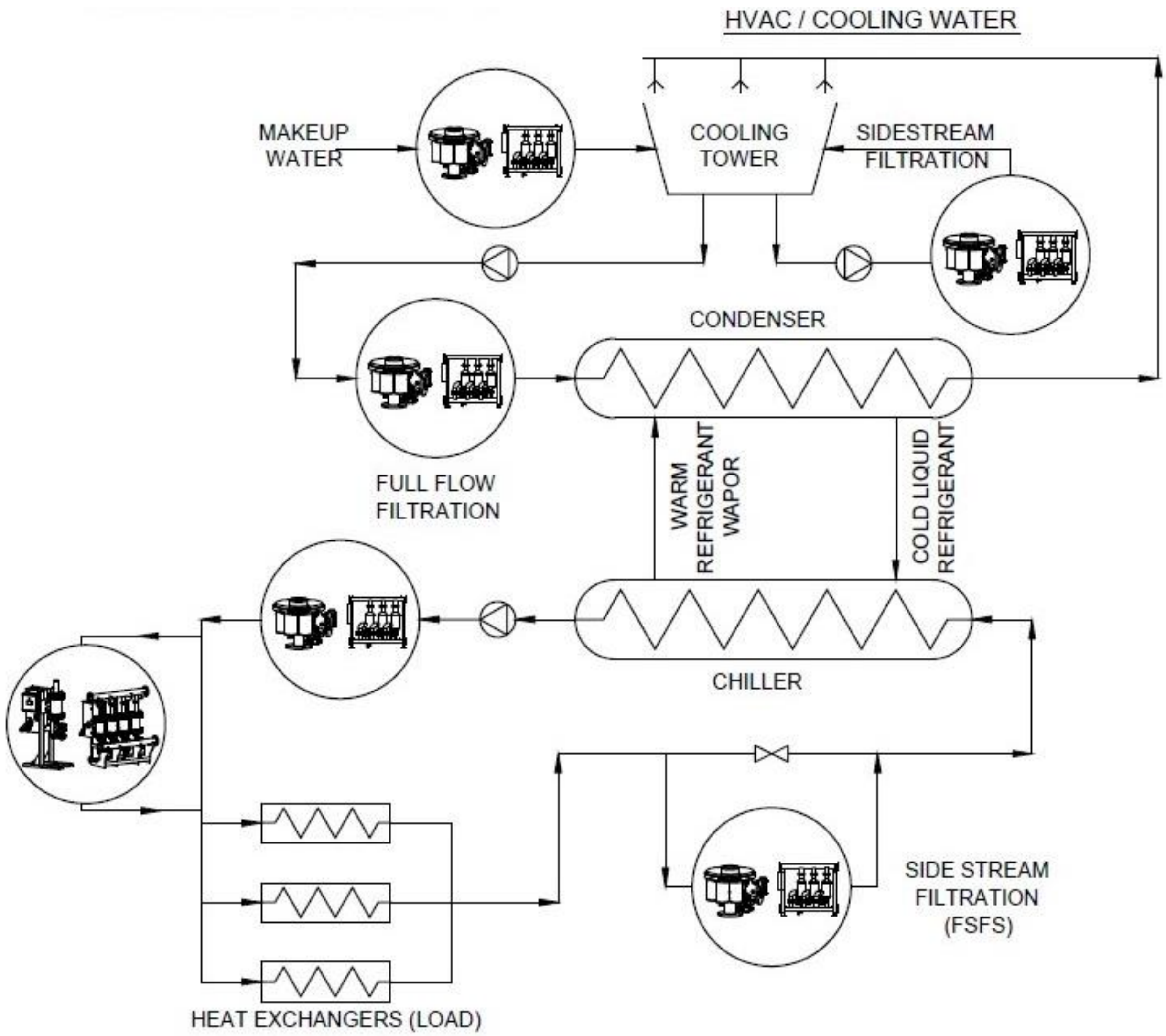
Cooling Water is used in almost every Commercial, Institutional and Industrial Building

Cooling water is used in virtually every industry (i.e. Automotive, Steel, Food Processing, Pulp & Paper, Oil & Gas, and Power Generation) for a variety of processes, as well as in HVAC (i.e. Heating, Ventilation and Air Conditioning) systems. Water is a significant aspect of a HVAC system. Industrial facilities, data processing operations, large office complexes, hospitals, universities, food, and chemical plants use water as a cooling medium in their HVAC systems. **The cooling water must be effectively filtered to remove suspended solids and other contaminants to protect the equipment in a process cooling or HVAC system to maximize heat transfer efficiency and minimize energy and water consumption**.

What makes up a Process Cooling or HVAC system?

The basic components of a process cooling, or HVAC system include the following:

- Compressor
- Condenser
- Chiller (Evaporator)
- Cooling Tower
- Heat Exchangers



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Where do we get the water used for Process Cooling or HVAC systems?

There are several sources for the cooling water including:

- Cooling Tower
- Surface Water (River, Lake, Reservoir)
- Well Water
- City Water
- Recycled Water

Cooling tower, recycled and surface water supplies, can be contaminated by airborne debris, dirt, silt, sand, pollen, algae, and other suspended solids and organic material. All these water sources can also be contaminated with pipe scale, corrosion by-products and other suspended solids. As the contaminants circulate through the system and deposit on the heat transfer surfaces of compressor intercoolers, chillers, condensers, and heat exchangers, they cause a reduction in heat transfer efficiency and increased pressure drop. **When you lose heat transfer efficiency and increase pressure drop, then you need to pump more cooling water to realize the same cooling. The net effect of contamination is increased energy and water consumption.**

How can the water impact the ability to cool AND operating costs?

Filtration helps keep the cooling water, cooling towers and all heat exchange surfaces clean and free of deposits which results in lower energy costs, less environmental impact, lower chemical costs, less equipment maintenance, longer equipment life, reduced worker exposure to contaminants that may present a health risk, lower overall operating costs and increased profits. Far too often, management and operations personnel overlook the impact that cooling equipment efficiency can have on profits. Even a marginal improvement in the efficiency of evaporative cooling equipment, heat exchangers, and chillers can offer significant savings over the lifespan of the cooling system. Improving the water quality in the cooling loop via implementation of filtration is a simple, cost effective method of realizing efficiency gains, reducing operating costs and increasing profits!

In evaporative cooling equipment (i.e. cooling towers), airborne debris like silt, sand, cottonwood seeds and many other undesirable contaminants are introduced into the cooling water. Dirty make-up water from pipe scale and corrosion products can also contribute to the build-up of contaminants. Other issues may arise from scale that builds up and flakes off inside the cooling tower, treatment chemical residue, and algae that can build-up and contaminate the circulation water. These are just a few sources of unwanted contaminants that can build-up over time and lead to poor water quality.

Automatic, non-disposable filtration technologies such as the proprietary ZGF Spring Filter (photograph below) have an even greater impact than other conventional filtration technologies.

ZGF Spring Filter Element

The Spring Filter element is manufactured with precision raised nidges. These nidges create an absolute gap that allow the Spring Filter to capture >99% of spherical particles larger than the micron rating of the filter. The ZGF Spring Filter is a stainless-steel coil wound with a variable pitch that allows the filter element to open evenly from top to bottom. While in backwash, the fluid flowing in the reverse direction causes the coil to open and “shimmer” which further enhances the cleaning capability during the backwash process. The full opening and shimmering of the Spring Filter ensure complete removal of contaminants with each backwash cycle. Even lodged or wedged particles are removed.

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Proper cooling water management, including effective and efficient filtration, leads to cost savings and higher heat transfer efficiencies allowing all the cooling equipment to operate as specified by the manufacturer.

Benefits of Filtration for Effective Removal of Suspended Solids from Cooling Water

- **20% - 40% Reduction in water consumption**: Improved filtration allows for increased cycles of concentration which reduces the demand for makeup water. Essentially, higher cycles of concentration mean that water is being recirculated through the system longer before blowdown is required. Less blowdown reduces the amount of makeup water required in the system, resulting in water savings.

- **10% - 30% Reduction in Energy Consumption:** Filtration reduces the likelihood of scale and fouling on the heat exchangers. Even the small amounts of dirt, scale, or biological deposits on heat transfer surfaces creates a layer of insulation that results in a loss of heat transfer efficiency and increased energy costs. When a heat transfer surface fouls, the flow of cooling water across transfer surface must increase or fan motors must work harder to maintain the same cooling. When pump and fan motors work harder, the amount of energy consumed increases.

- **20% - 70% Reduction in Chemical Usage:** Dirty water requires more treatment chemicals than clean water. Chemicals are used to bind suspended particles in the water stream and prevent scaling and corrosion. As suspended solids increase, treatment chemical efficacy decreases. Higher chemical dosages and / or more frequent chemical additions are then necessary provide the desired results. Cleaner cooling water also eliminates the need for "dispersant" chemicals that are often required for efficacy of scale prevention chemicals and biocides.

- **Lower maintenance cost:** Traditionally, cooling towers are cleaned by draining the tower and mechanically or manually removing the sediment from the sump. Costs associated with the cleaning process include downtime, labor, lost water, and additional chemicals. Cooling systems that are cleaned continuously via filtration routinely provide longer periods of continuous operation before being taken off-line for required maintenance.

- **Improved productivity and less downtime:** Heat removal is critical in many processes and manufacturing operations. Fouled heat exchange surfaces can force an operation slow down or completely halt production. Cleaning and / or replacement of heat exchangers results in downtime. Lost and / or reduced production results in lost profits.

- **Safer Work Environment / Minimized Worker Exposure**: Biological growth control and reduction can mitigate potential health problems, such as those caused by Legionella. ASHRAE Guideline 12- 2000 has basic treatment recommendations for control and prevention, stating that the key to success is system cleanliness. Legionella and other microorganisms thrive where there are nutrients to aid their growth and surfaces on which to live. Filtration can minimize habitat surfaces and nutrients by maintaining lower particle levels in the water stream. Filtration also minimizes worker exposure by reducing chemical usage and maintenance.

If maximizing profitability and creating safe work environment is a fundamental objective of a business, then optimizing cooling water filtration is not an option but rather a basic requirement!

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Where should filtration be installed?

The best practice is to employ cooling tower basin filtration along with full flow or side stream filtration.

Basin filtration (i.e. filtration with basin sweeping using eductors) is a side-stream configuration with a dedicated circulation pump. Dirty water is pumped through the filtration system and returns to the basin through an arrangement of nozzles that are designed to "sweep" the solids toward the suction basin filtration system supply pump. This arrangement prevents solids from settling and accumulating in basin and significantly reduces or eliminates the need for manual cleaning of basin. Manual basin cleaning is a labor-intensive task that increases worker exposure to contaminants that present a potential health risk. Furthermore, the filtration system provides continuous cleaning (i.e. continuous unattended maintenance) whereas a maintenance crew can only clean the basin at scheduled intervals.

Basin filtration minimizes cooling tower maintenance and does reduce the overall amount of suspended solids in the cooling water but does not provide direct protection to the heat exchangers, condensers, or chillers.

Centrifugal separator technology can be very effective when implemented for cooling tower basin cleaning. The patented, ZGF Tornado centrifugal separator (image to the right) puts a new spin on an established technology! **The innovative Tornado separator utilizes an internal blade design. The blades create a unique and beneficial flow path through the separator that increases the "G – Force" with a pressure drop of less than 1 psi, resulting in more effective and efficient particle removal with less energy consumption**.

Full flow and / or side stream filtration will provide direct protection to the heat exchangers, condensers, or chillers by removing the suspended solids and other unwanted particles from the cooling water preventing formation of deposits on the heat transfer surfaces of this critical equipment.

ZGF offers the most advanced, automatic, non-disposable liquid filtration systems. All ZGF EZ Clean filtration systems utilize the proprietary, non-disposable, absolute gap Spring Filter elements with micron ratings ranging from 20 – 400 micron. ZGF EZ Clean filtration systems provide for uninterrupted flow of filtered cooling water even during backwash and require virtually zero maintenance.

Full flow filtration provides the best protection because 100% of the cooling water must flow through the filtration system before it reaches the critical heat transfer equipment. The ZGF EZ Clean EC700S is ideal for full flow filtration. The EC700S's modular "pod" design can meet any flow requirement greater than 200 gpm.

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Side stream filtration is a cost-effective alternative to full flow filtration because it continuously filters a percentage of the flow instead of the entire flow. Properly sizing a side stream filtration system is critical to achieve desirable results. An often-used guideline is to size a filter that can handle a flow rate that turns the system volume over, at a minimum, once an hour. This flow rate generally ranges from as low as 3% up to 10% of the total circulation flowrate. Side stream flowrates up to 30% of the circulation flowrate are not uncommon. Since only a percentage of the water is filtered at a time, some solids do bypass the filter and remain in the circulating cooling water. **Therefore, higher side-stream flowrates are always better.** The EZ Clean Phoenix is an ideal side stream filter and is also an option for full designs when flow requirement is between 40 – 250 gpm.

Do I need to remove all the particles?

No, you do NOT need to remove all the suspended solids form the cooling water. But knowing the number and size distribution of the particles is critical aspect of filtration system design.

The biggest design flaw in cooling water filtration is also the most common. Many firms design systems to filter 3% of the flow at 5 µ - 10 µ. Whereas it is more prudent to filter 10% - 30% at 35 µ - 75 µ as determined by the data from a particle count and size distribution analysis.

When evaluating particle count and size distribution data, the greatest number of particles is NOT your primary filtration concern. You really need to consider the volume of space that particles occupy. Smaller numbers of larger particles occupy more space than larger numbers of small particles. If just 15% of the particles range from 20 µ - 75 µ, that can represent 95% – 99% of total volume of particles. Larger (i.e. heavier particles) will have a greater tendency to deposit in areas of low velocity creating nucleation sites and the build-up of more particles. This phenomenon can lead plugged spray nozzles, fouled heat exchange surfaces and deposition in the basin. A small percentage of larger particles is the bigger concern than a large percentage of small particles.

Evaluate particle count and size distribution data. Design a filtration system to effectively capture and remove the greatest volume of particles rather than the greatest number of particles. Higher circulation rates with higher micron filters (based on lab data) designed to remove higher volumes of particles is much better than low circulation rates designed to capture a low volume, high number of particles.

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Summary

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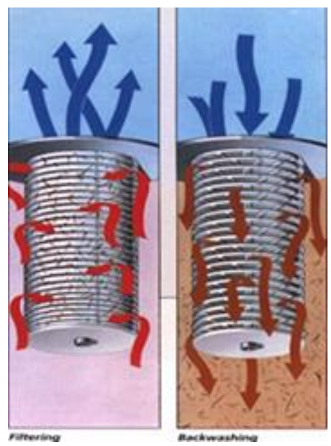
- **Cooling Water can be contaminated by airborne debris, dirt, silt, sand, pollen, algae, and other suspended solids and organic material, as well as by pipe scale, corrosion by-products, treatment chemical residue and other suspended solids.**
- **The cooling water must be effectively filtered to remove suspended solids and other contaminants to protect the equipment in a process cooling or HVAC system to maximize heat transfer efficiency and minimize energy and water consumption.**
- **Filtration helps keep the cooling water, cooling towers and all heat exchange surfaces clean and free of deposits which results in lower energy costs, less environmental impact, lower chemical costs, less equipment maintenance, longer equipment life, reduced worker exposure to contaminants that may present a health risk, lower overall operating costs and increased profits.**
- **The best practice is to employ cooling tower basin filtration along with full flow or side stream filtration.**
- **Evaluate particle count and size distribution data. Design a filtration system to effectively capture and remove the greatest volume of particles rather than the greatest number of particles.**

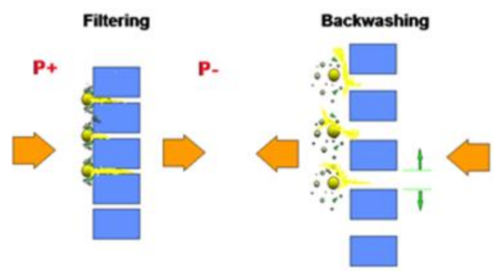
If maximizing profitability and creating safe work environment is a fundamental objective of a business, then optimizing cooling water filtration is not an option but rather a basic requirement!

The ZGF Spring Filter (www.zgfilters.com) element sets the standard for permanent media, fully automatic, self-cleaning filters. The absolute gap allows for efficient and effective particle capture from liquids; and the unique continuous coil design ensures complete cleaning of the filter element with each backwash. The proprietary, non-disposable, absolute gap filter elements are available in micron ratings ranging from 20 – 400 micron and are guaranteed for 5-years!

The ZGF Spring Filter element to opens uniformly along its entire length during backwash. The benefits are as follows:

1. Particles wedged or lodged are quickly released and washed away as the gap is increased.
2. The Spring filter element "shimmers" which further enhances the cleaning process.
3. The moment the filter element begins to open during backwash, the fluid velocity is instantaneously increased and subsequently followed by a surge in flow that scours the coil effectively and efficiently removing the contaminants.





100% clean with each and every backwash