HIGH EFFICIENCY 0.5 & 0.25 MICRON COOLING WATER FILTRATION SYSTEM

THE HIGHEST QUALITY COMMERCIAL AND INDUSTRIAL WATER FILTRATION EQUIPMENT

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According to the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Guideline 02-2000 - Minimizing the Risk of Legionellosis Associated with Building Water Systems (Section 7.6.2),

"Objectives of water treatment for cooling water systems [are] to use water effectively as well as to minimize growth, minimize scale, minimize corrosion, [and to] minimize sediment/deposition of solids (organic or inorganic) on heat transfer surfaces. An effective water treatment program should allow more efficient operation due to lower fouling, a longer system life due to decreased corrosion, and safer operation of the system due to reduced chances of microbiological exposure to the public."

Cooling towers and chiller systems are an important component in any industrial HVAC system. Unfortunately, the water that flows through these systems is easily contaminated by airborne particulates such as dirt, dust, pollen, bacteria, and stack emissions. In addition, corrosion products and process leaks further add to potential suspended solids problems. Though the majority of these contaminants are far smaller than any particle visible to the naked eye, and they collect and can escalate the operation and maintenance costs for such cooling and thermal transfer systems by surprising amounts.

If left uncleaned, accumulated sediment and other undesired material can provide a more suitable environment for the growth of biological material such as bacteria, algae, and pathogens like Legionella pneumophila (the cause of Legionnaires’ disease). These deposits must be closely maintained to ensure that there are no deadly outbreaks of Legionnaires’ disease or other illnesses. Infections from these bacteria are known to be fatal in humans, so it is crucial to ensure that cooling and chill systems are clean in order to avoid unnecessary loss of life.

Suspended solids in cooling systems can also cause undesired effects for each of the system components. As these solids travel through a system, they collect in nozzles, valves, and other fittings and can cause a decrease in pressure and efficiency as well as early degradation. This build-up is also a problem in pumps as it requires that they are cleaned often to avoid corrosion or early replacement. The accretion of particulates in these components lends to a decrease in heat transfer efficiency, so more energy is required by the system to increase the flow rate and consistently produce the desired results. The costs to clean, repair, and replace valves, pumps, and other components may be a great strain on any company. These costs, however, are dwarfed by rising energy costs that are required to maintain a certain level of heat transfer efficiency.

As energy prices continue to rise, it becomes increasingly important to search for alternative methods of power or energy conservation. The easiest and most cost-effective manner in accomplishing this goal in cooling systems is to add a filter for cooling water. High-efficiency sidestream cooling tower water filtration removes most particulates and sediments from the system altogether. It reduces the maintenance on individual components as well as the system as a whole by practically eliminating the need for system shut-downs and cleaning. Filtration removes abrasive materials from the system line and helps maintain a clean, bacteria-free environment, thus increasing system life and protecting an expensive investment.
In the past, chemicals were needed to treat the inflowing water and dissolve particles; a supreme level of effectiveness in water filtration had never been achieved through the use of green technology. It was Diamond Water Systems’ commitment to green technology and the idea that harmful chemicals are unnecessary for highly effective water filtration that brought about significant changes in the market as a whole.

Diamond continues its tradition of offering high-efficiency, highly-effective filtration systems that rely solely upon technology and innovation rather than dangerous chemicals to clean water to the 0.25 micron nominal size level. Because Diamond Water is the leader in developing this new technology, which is backed with expert engineering services and support to benefit the customer, it has remained a leader in the industrial water filtration market and has provided its customers with quality machines that have the capability of returning their investment in a short amount of time and with a significant reduction in environmentally detrimental effects.

### Business and the Biosphere

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Cover photo: TSA-830 system with eight 30-inch diameter stainless steel vessels. Filter operates at 800gpm and filters particulates to 0.5 microns in nominal size. Piping configured for system water backwash with pneumatically actuated bronze diaphragm valves; Right: Diamond Water service truck at a cooling tower site.
One of the most commonly-used practices for filtration of cooling water is sidestream granular media (sand) filtration. The filtration process begins when contaminated water enters the top distributor of the vessel and is directed toward the outer wall. Upon impact, the contaminated water reverses direction across the surface of the filter media. The media compresses so that the contaminants cannot penetrate the filter bed.

This crossflow filtration process forces the contaminants above the surface of the media and allows only the filtered water to pass through the media.

Once the area above just above the filter media becomes saturated, the filtration system will require backwashing. Since the contaminants have not deeply penetrated and are mainly on the surface of the filter media, backwashing requires less time and water. The flow is reversed to loosen the media and allow the system to discharge the contaminants.
Sidestream filtration can involve a single filtration vessel or multiple vessels working together to control the suspended solids levels in cooling water. The design of such systems depends upon the particular application and desired flow rate. Diamond Water Systems, Inc. prides itself on its relationships with customers and its commitment to individually engineered filtration systems. Where some water filtration companies may only offer standard filter models, Diamond Water Systems works with the customer to design a filtration system that will be the most efficient solution to their cooling or chilled water problems. System construction does not begin until both Diamond Water Systems and the customer are completely satisfied with the particular design.

While Diamond Water does not build and stock standard systems, its team of consulting engineers can often recommend a typical Diamond Water design and any changes that might be required for the particular application. This design process ensures that your filtration system is unique to meet your specific needs and is built exactly to your specifications so that you don’t pay for components that may be unnecessary.
To clean cooling water, the quantity and size of contaminant particles must first be determined. Visual inspection is inadequate since most suspended matter is smaller than can be seen with the naked eye (below 40 micron). This distribution can be seen in the figure below. Large particles settle out in tower sumps, but most particles are extremely fine and keep recirculating across heat exchange surfaces until they are discharged by blowdown.

On-site testing quickly determines both the degree of contamination and particle size. Test results can be used to compare the effectiveness of various filtration technologies and determine proper filter sizing.

There are many factors that lend to high prices when it comes to owning and maintaining a cooling tower water system. It all begins with the increasing cost of energy that is required to run the system. As the system is used, bacteria and depositions such as scale form. Not only do these depositions cause the cooling system to become less efficient, but they also increase both the rate of corrosion due to microbiological factors and the fouling factor of film fill. This increase will in turn cause a required increase in energy to run the system. The percent from average increase in electrical costs is shown as a function of the fouling factor in the figure below.

Unfiltered water in cooling towers also leads to build-up in heat exchangers and tower sumps, which eventually require extensive cleaning or even premature replacement. Combined with the increased energy costs, it can be very expensive to clean and maintain a cooling system.

TSA-130 (0.5 micron) single, 30-inch vessel filtration system with pneumatically actuated bronze diaphragm valves and PVC manifold. Designed to be backwashed using city water.
Diamond Water Systems’ seasoned engineering consultants will work with you to determine which system would be best for your particular cooling water application. Standard systems are available for system flow rates ranging from 12 gallons per minute to over 4000 gallons per minute, but it is always possible to design custom systems to meet any particular needs you may have.

The secret to successful cooling water filtration is being able to remove extremely fine particles in a cost-effective manner. Diamond’s state-of-the-art design utilizes ultrafine sand to rid your cooling water of contaminants—not just to the 10 to 30 micron size that other filters can—but all the way down to 0.5 micron or even 0.25 micron in special systems.

Since most cooling water particles are in the 0.5 to 5 micron size range, Diamond filters set new efficiency standards for sidestream filtration. Not only does the resulting crystal clear water maximize filtration benefits, but high efficiency filters can be sized much smaller than traditional systems.

The outstanding performance and compact size of the Diamond filter now makes sidestream filtration a cost-effective must for every cooling system. With a quick return on investment, Diamond Water’s filtration systems show a deep commitment to protecting the environment by relying upon in-house research, development, and innovation rather than harsh chemicals to clean water to microscopic levels once thought impossible.
In the same way that cooling systems are contaminated with particulates that are generally 0.5 micron in nominal size or smaller, closed-loop systems such as chillers and heat exchangers are also often destroyed by similar particulates coming from within the system. These particulates build up over time as they deposit on open surfaces in the systems, and this build-up can significantly reduce heat transfer efficiency.

**False:** Because closed-loop systems such as chillers and heat exchangers recirculate water with no intake from other sources, there is no need to worry about build-up of particulates or other debris.

General maintenance practices for closed-loop systems include basic cleaning and removal of large areas of build-up. These regular cleanings are crucial to system life, but sometimes more extensive cleanings are required when heat transfer efficiency levels fall too low. When this occurs, unscheduled shut-downs of the system must take place in order to remove the remaining problematic residue. These shut-downs can be very costly, but if a closed-loop system is properly cared for, the frequency of these cleanings will decrease.

**True:** Though closed-loop systems do not utilize water sources or intakes, particulates and other unwanted materials still collect on surfaces. Because of this, closed-loop systems still require intensive cleaning and regular maintenance to ensure that heat transfer efficiency is not lost and the system’s performance is not jeopardized.

There are many methods for cleaning a closed-loop system, but often the only possibility considered is the old-fashioned system shut-down for debris removal. This method is often chosen because it is seemingly the most cost-effective and efficient manner of cleaning such a system, but this is not actually true as it requires that the system be put off-line, partially disassembled and inspected for problems, and cleaned thoroughly before it is reassembled and returned to normal operation. There are, of course, labor costs involved in this process, and if there are any problems found with parts or components, the issues must be addressed before the system can be put back online. The more time that elapses while the system is off-line, the most expensive the particular shut-down grows.
The easiest and most reliable way to maintain the overall cleanliness of a chiller or heat exchanger is through high efficiency filtration. A properly-designed filtration system can reduce the number of unscheduled system shut-downs for cleaning as well as reduce the frequency of part and component replacements.

Fewer shut-downs, part and component replacements, and less spending for labor costs during system cleanings can save significant amounts of money. In addition, a fully cleaned system will be more functional in terms of heat transfer, and this will in turn reduce energy costs. These extra costs for owning and operating a closed-loop system would be virtually eliminated with a high-efficiency filtration system designed to work in sync with existing piping and flows.

Diamond Water Systems engineers can suggest the best methods and designs for filtration of closed-loop systems. Diamond Water filtration systems often show a 6-18 month Return on Investment (ROI), so you’ll know that your investment for clean circulating water will be worthwhile. In addition, you’ll be confident in knowing that not only was your filtration system designed to perfectly meet your particular needs, but it is backed by outstanding service and support from in-house technical experts and engineers who can answer any questions that you may have.

TSA-230 Tall (0.5 micron) double-vessel chiller filtration system with PVC manifold, hydraulically actuated bronze diaphragm valves, and a flow rate of 200 gpm.

TSA-116 Tall (0.25 micron) single-vessel chiller filtration system with flow rate of 20 gpm, PVC manifold, and bronze diaphragm valves.
Removing suspended solids from cooling water is the surest way to prevent fouling of heat transfer surfaces. Diamond filters greatly reduce costly deposits to help maintain maximum design efficiency.

Independent tests show that high efficiency filtration produces dramatic energy savings.

Corrosion rates throughout the cooling system can be decreased markedly by maintaining clean water.

Chemical inhibitors form a more complete protective film on clean metal surfaces, while underdeposit corrosion is minimized.

Microbiologically influenced corrosion is much easier to control with clean cooling water.

Unscheduled downtime can be extremely costly. Maintaining clean recirculating water is not only sound preventative maintenance, but it also reduces heat exchanger and tower sump cleaning costs.

The large surface area of film fill improves tower efficiency, but demands high efficiency filtration to prevent suspended solids from fouling.

Above: Portable TSA-112 (0.5 micron) single-vessel filtration system with hydraulically actuated bronze diaphragm valves and a black iron manifold. Designed for high temperature operation; Right: TSA-116 Tall (0.25 micron) single-vessel chiller filtration system with PVC manifold, electrically actuated ball valves, and flow rate of 20 gpm.