

**COOLING
WATER
SYSTEM
OPTIMIZATION**

Elevate your cooling water system to save time, money and resources.





BUCKMAN'S TOTAL APPROACH:

The only place for growth is on the bottom line.

Water is a key player in cooling systems of all types. It serves as an excellent solvent and heat transfer agent. Yet, as water plays the hero in cooling systems, it also serves as its own worst enemy. While water works to dissolve impurities, these substances can become corrosive and destructive. The remaining particulate matter often builds to the point that solubility is no longer possible and efficiency-threatening scale forms. In addition, water indiscriminately supports life—including algae and bacteria which work to reduce water quality, foul system surfaces and promote corrosion. High quality water ensures an efficient operation and increased equipment life.

For these reasons, water in cooling systems must be specially treated and monitored. When scale and microbiological fouling are controlled, cooling water runs free and clean, maximizing its ability to absorb heat and carry it away, leaving your systems cool and running efficiently.

At Buckman, we know the key is water treatment optimization—the ability to not only apply the right chemistries, but also to monitor and control water quality while keeping it balanced. When you keep contaminants from growing in your system, you can grow the bottom line—increasing production, reducing downtime and lowering operational costs.



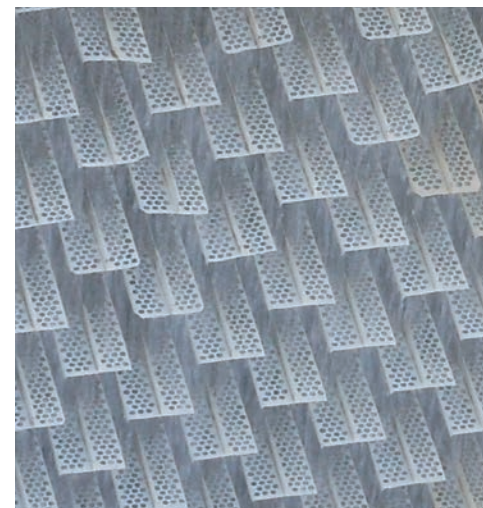
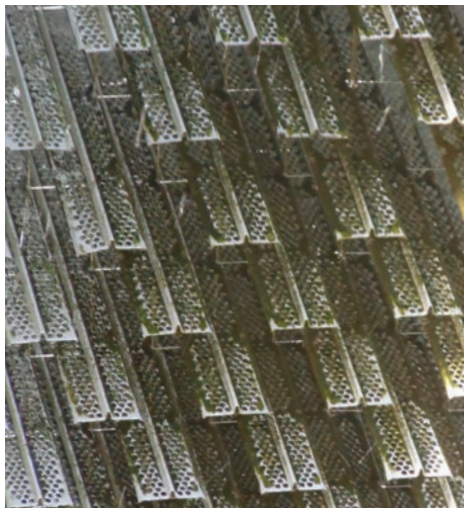
BUCKMAN'S TOTAL APPROACH:

Successful cooling water management is part chemical, part technological and part human.

Buckman brings all three aspects to your plant, working hands-on, on-site to assess, treat, and maintain cooling water system performance. We help minimize downtime and reduce maintenance and operating expenses, resulting in operational and natural resource savings and a stronger return on investment.

Buckman offers a comprehensive range of cooling water treatment support and monitoring programs that work together to maintain your cooling water system's balance—from testing and analysis, troubleshooting, to industry-leading chemistries and advanced monitoring technologies. Our strategy goes well beyond chemicals to include advanced diagnostics, continuous monitoring and precision control.



Before (immediate right) and after (far right) images of a cooling tower fill section demonstrating the efficacy of Oxamine® at removing biofilm formation with minimal impact on system corrosion rates or treatment chemistries.



BUCKMAN'S TOTAL APPROACH:

Key chemistries, advanced protection

Buckman is an innovator in the global specialty chemical industry with more than 70 years of proven success and expertise. Our industry-leading chemistries and feed technology work to keep cooling towers, closed loop systems, chillers and feed systems clean, thereby increasing your operation's efficiency and productivity. Our chemical programs are designed to control or eliminate specific issues such as scale and scale-like deposits, fouling, microbiological deposits and foam.

 PROBLEM	 BUCKMAN SOLUTION
Microbiologicals	Buckman offers a full line of biocides incorporating both general and specific targeting characteristics. Buckman's Bulab® system of products offers 34 active ingredients to provide bacterial and fungal protection, slime control, mold inhibition and spore control. Buckman also offers environmental solutions, including our technologically advanced Oxamine® system, which can out-perform conventional oxidizing biocides, yet is more environmentally-friendly.
Organics	You can rely on Buckman for a variety of organic dispersants. Buckman's special blend of surfactants controls organic deposits like oil, grease, slime and films that not only inhibit heat transfer, but also prevent corrosion inhibitors from doing their job.
Corrosion & Scale	Corrosion and scale fighting options available from Buckman include combination scale/corrosion inhibitors along with our own PCA Plus program. It is designed to control calcium carbonate, calcium phosphate, calcium sulfate and silica levels—all enemies of heat transfer in your cooling water systems.
Closed Loop Deposits	Shutting down a closed loop system for cleaning is costly. That's why Buckman developed a series of products for on-line cleaning systems. This series is strong enough to purge your closed loop system of deposits, yet gentle enough to avoid damage to metal or plastics. The result is a passive surface which allows for a clean, free-flowing system that remains in operation.
Foam	Buckman has a full range of defoamers to calm the waters in all areas of your cooling water system.

BUCKMAN'S TOTAL APPROACH:

Specialized tools, superior performance

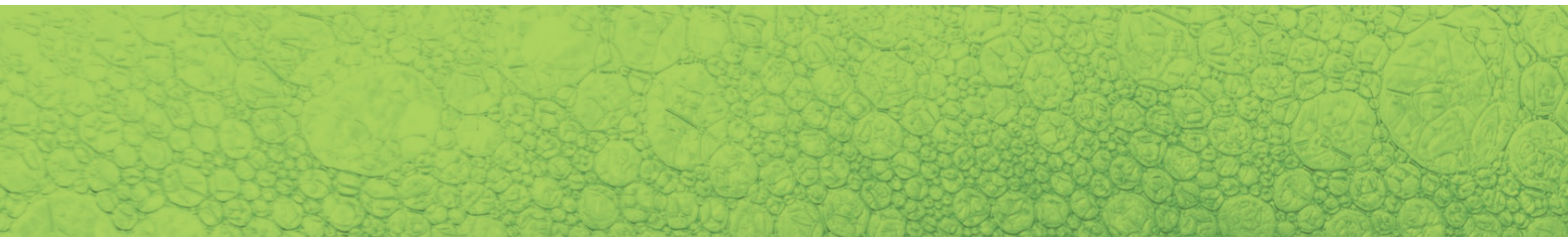
Despite the commonalities found in cooling water treatment operations, not every water cooling operation issue is exactly alike. Simply applying a chemical program to an issue does not always solve the problem. Often times, it exacerbates the problem or even multiplies the issue. This blind overtreatment or undertreatment has serious consequences for system efficiency, treatment costs and the environment. That is why Buckman focuses on continuous research and development of advanced diagnostic and monitoring technologies that can help improve system efficiency and reduce the capital costs. Buckman has the knowledge

and tools necessary to ensure consistent water quality and precision dosing, eliminating wasteful spending and boosting productivity. We believe it to be necessary that plant operating and supervisory personnel have access to process data and information easily and readily. We employ monitoring and management tools that include our exclusive Buckman OnSite[®], Buckman Process Counselor, the Buckman MicroBio Advisor,[™] EZE Monitor[®] system, and the Buckman Green Toolbox. These tools work to reduce chemical costs, decrease equipment cleaning expenses, extend equipment life and protect the environment.

Buckman OnSite[®]

Our exclusive web-based customer portal and real time dashboard interface gives customers and Buckman service representatives access to vital information about customer operations—manual and automated controller data updates, material safety data sheets and more. Buckman OnSite measurement tools can be tailored uniquely to fit your data collection requirements and accessed easily in real time.

For Buckman, it saves valuable time typically spent by service representatives compiling customer service reports. For customers, it offers a new level of visibility into your own processes, putting data and documentation at your fingertips, no matter where you are. Just as important, when you can see your operation's data on demand, you can not only monitor your own success, but also see more clearly the value Buckman brings to your operation.



Buckman Green Toolbox

For Buckman and our customers, return on investment (ROI) is only part of the goal. We also look for return on environment (ROE). The Buckman Green Toolbox is a computer program that allows the user to calculate ROE based on measurable factors, including:

- Economics
- Risk
- Water use
- Social impact
- Energy use
- Competitive advantage
- Waste

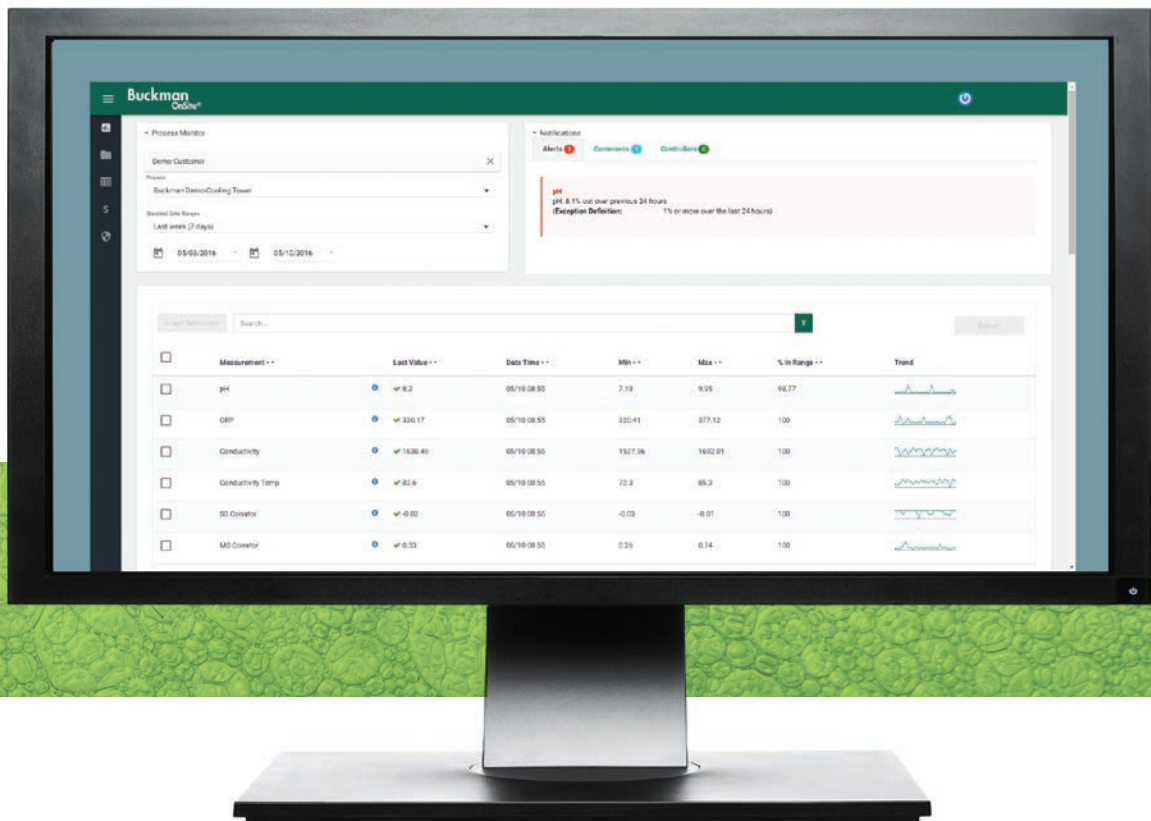
With this data, the program then calculates a value for each project. Additionally, the value found in the Buckman Green Toolbox is that it can be used in conjunction with our other monitoring technologies. This allows us to predict problematic species and identify the areas they threaten in your operation, identify reuse streams and align your system with your water use strategy, and optimize operational conditions.

Buckman EZe Monitor®

EZe Monitor is a comprehensive on-line plant system that tracks all water quality parameters—pH, ORP, corrosion rate, and conductivity—as well as chemical treatment levels continuously and accurately. It adjusts automatically the feed of treatment chemical to the appropriate

specifications. Real time assessment and control improves operational efficiency and helps reduce environmental impact. In addition, EZe Monitor can be accessed remotely and linked with Buckman OnSite®, our customer portal and data dashboard.

Buckman OnSite® dashboard interface provides quick access to continuous reporting and valuable insight into the customer's internal processes.



BUCKMAN'S TOTAL APPROACH:

Evaluation, education

As part of Buckman's total approach to a customer's cooling water treatment program, we understand the ultimate success of the operation depends on plant personnel – both at the operator and supervisory levels. We engage the appropriate facility stakeholders in our assessments, analyses and extensive on-site training.

Buckman's experienced field engineers, backed by our expansive global laboratory resources, will audit your system, find ways to improve it, and then apply just the right technologies to get the job done effectively and efficiently. We offer innovative solutions for every issue. Look to Buckman to help provide:

- ATP testing
- Biocide efficacy assessments
- Efficiency evaluations
- Inspections and analytical support

With these hands-on assessments coupled with our total approach to cooling water treatment, we can help you overcome your immediate challenges and threats and prioritize and implement more effective long-term solutions that will grow your bottom line.

Focusing on the needs of the customer and meeting those needs are the ways we measure success. Your cooling water system's biggest challenge could be an undiscovered opportunity to increase your return on investment when paired with Buckman solutions. Our problem solving process brings a unique merger of chemistry, environmental sustainability and business expertise for a comprehensive understanding and solution to your challenges.



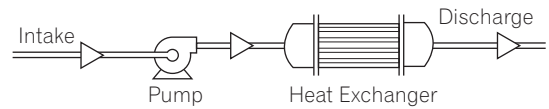
BUCKMAN'S TOTAL APPROACH:

Types of Cooling Systems

The basic function of cooling water is to remove heat from a process by transferring it from some medium into the cooling water for dissipation. There are three basic types of cooling systems: once-through cooling systems, open recirculating systems and closed recirculating systems.

Once-Through

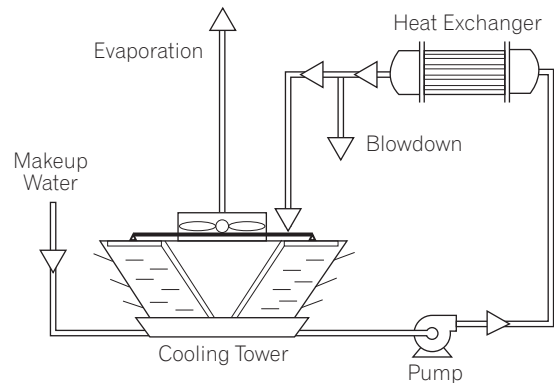
A once-through cooling system pumps water into equipment where it passes across a hot surface in order to cool it. The water then exits the equipment, taking the heat with it. Simple and effective in a wide range of applications, this system can be undermined by the quality of the raw water. Lakes and rivers can bring in



suspended matter and pollutants. Well waters can contribute large amounts of iron and scale-forming materials. Because water is only used once, a large amount of water is required.

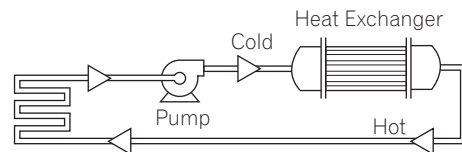
Open Recirculating

This system sends cooling water out of the equipment and into a pond or cooling tower that is open to the atmosphere. Here, evaporation occurs, removing heat along with the evaporated water. As a result, the remaining water cools. It is then combined with makeup water, which replaces the evaporated water, and is, again, sent through the system. Open-recirculating systems are prevalent as water is scarcer and environmental restrictions are placed on bleedoff discharge.



Closed Recirculating

All water used to carry heat away from equipment runs through a heat exchanger, which is cooled by air, mechanical refrigeration or a separate open cooling water system. There is no evaporation or makeup water required, so contamination—and the maintenance that results—is less likely. Since the same water is used over and over, water



and sewage costs are lower and environmental compliance is easier. Many once-through systems are converted to closed systems for this reason.

Specialized Systems

A specialized cooling system might utilize compression or absorption-type refrigeration or air conditioning systems, which can be used to cool both processes and work spaces. It might utilize a cooling coil below the deck of the cooling

tower. Or it might include the use of industrial air washers in which air is filtered, sprayed and then forced through a series of mist eliminators. Each system has its own unique risks for fouling and must be treated accordingly.

BUCKMAN'S TOTAL APPROACH:

Common Cooling Water Issues

The enemies of cooling water are many. Sometimes they work alone, sometimes in tandem compounding the problem. For example, algae growth creates the perfect environment for corrosion to take hold. In a cooling water system, problems such as scaling, corrosion, organic fouling, microbiological deposition, and foam can damage expensive equipment and interrupt daily plant operation.

Scale

Scale and scale-like deposits build up on heat exchanger tubes which reduce heat transfer. Additionally, in sufficient amounts scale can restrict water flow. When heat transfer is reduced, efficiency of production is reduced and the quality of products can be compromised. Equipment can suffer damage from overheating. Scale can cause expensive downtime for cleaning or repair, resulting in lost revenue. In addition, scale and scale-like deposits can accelerate corrosion.

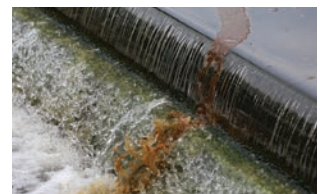


Corrosion

Corrosion causes pitting and leaks in cooling systems and can lead to the replacement of pipes, pumps, heat exchanger tubes and even entire cooling towers. Iron oxide, especially, contributes to fouling and deposition, which, in turn, interfere with heat transfer. Downtime for equipment repair or replacement is always costly.

Organic Fouling

Mud, sand, silt, clay, biological matter and even oil can enter the system through its makeup supply or from the air. These suspended materials can accumulate and settle in the system, blocking flow and reducing efficiency. Oil film can reduce heat transfer and encourage the growth of microorganisms.



Microbiological Deposits

Biofilms severely restrict heat transfer. Slime masses bind inorganic and organic foulants and plug systems. Algae and fungi cause extensive plugging and fouling of heat exchanger tubes, water lines, tower spray nozzles, distribution pans, screens and fill. Microbiological fouling also contributes to under-deposit corrosion as well as the growth of corrosion-causing bacteria.

Foam

Cascading water, the continuous recycling of contaminants and a high concentration of foam stabilizers can cause foam to overflow the tower sump, blow off the towers or even cause an airlock in the water pumps. Worst of all, the presence of foam concentrates deposit-forming materials in the water, thus increasing the chance of fouling in the treatment system.





To battle the enemies of heat transfer successfully, Buckman understands you need a comprehensive approach that controls costs as effectively as it controls fouling. We work with you to supply not just the advanced chemistries and tools necessary to combat cooling water issues such as corrosion and microbial problems, but the knowledge and expertise tailored specifically to your operation's needs. Our solutions are designed not only with your cooling water system in mind, but also the environment as well.

Bring a new level of performance to your cooling water systems.

At Buckman, we have dedicated ourselves to developing biodegradable and naturally derived products to replace less sustainable options—innovations like enzyme technologies and patented chloramine water treatments. We have learned how to reuse effluent waters, recycle process waters and leverage alternative water sources. And we have developed predictive modeling and performance-enhancing software to provide unprecedented precision and control of your plant's operations and resources.

Today, there are more tools and more technologies than ever to help you save money, protect the environment and enhance your company's image. Ultimately, we do not produce just chemicals. We create reactions. Our success and, moreover, our customers' success depends on this.

Find out more. Speak with a Buckman representative or visit buckman.com. Together, we can keep your water systems running cleaner and cooler. So, you can keep your entire plant running more efficiently and increase your return on investment.

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