

PROCESS COOLING & EQUIPMENT

A Supplement to Process Heating

CHEMICAL-FREE Water treatment

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What do a chemical technology center, a peaker power plant, an international agricultural business and a razor-blade manufacturer all have in common? Astute management policies, a desire reduce water and energy consumption in an environmentally sustainable manner, and a need to improve the bottom line of their operations drove these businesses to implement the same water treatment technology. The Dolphin System from Clearwater Systems Corp., Essex, Conn., uses electrical pulsed power rather than chemicals to control scale, microbial growth and corrosion (see sidebar).

Four case histories demonstrate how these enterprises made the transition from chemically fed water treatment to chemical-free technology for process cooling systems at their facilities. Each had its own priorities for doing so, but they were all for the right reasons.

Controlling Scale and Biological Fouling

The Dow Chemical Technology Center in Charleston, W.Va., develops and evaluates new products for Dow Chemical. The center also builds small prototype systems that serve as a blueprint for full plant operations at other locations.

Several years ago, the center was experiencing problems with scale and biological fouling



The pulsed-power water treatment system controls scale, biological growth and corrosion at the Dow Chemical Technology Center.

from the city water used in its process cooling systems. The facility installed a pulsed-power water treatment system. Within a few weeks, the process water changed from a murky greenish brown to clear. The center was so



Within a few weeks of installing the pulsed-power water treatment system, the process water at the Dow Chemical Technology Center changed from a murky greenish brown to crystal clear.

impressed with the water treatment system's performance that it experimented by changing its makeup water from city water to nearby river water. Again, the system controlled scale, biological growth and corrosion and produced clear water. The blowdown water was deposited back in the river, which saved the center significant costs in both water use and disposal operations.



To improve turbine cooling and prevent generator de-rating, the Red Bluff peaker power plant installed 16 fluid coolers, each of which is connected to a pulsed-power water treatment unit on the water circulation loop.

Providing Energy without Environmental Sacrifice

Sixteen independent engine generators are installed at the Red Bluff peaker power plant in Red Bluff, Calif. Like all peaker power plants, Red Bluff is generally run only when there is a high demand for electricity. During

those times, the plant comes online to provide precisely the amount of electrical energy that the California electrical grid needs.

At Red Bluff, each generator is rated at 2.8 MW and can come up to full power in 30 min. Each motor operates on natural gas with twin turbines for air compression. If the turbine temperature exceeds 109°F (43°C), the power output of the generator must be de-rated.

To improve turbine cooling and prevent generator de-rating, the plant installed 16 fluid coolers; each cooler uses 8.5 hp. These units save more than 0.13 MW under a full station load. Effective water treatment is important for keeping the fluid coolers online, so each cooler is con-



The pulsed-power water treatment system at the Red Bluff peaker power plant has reduced blowdown from more than 80 gal/min to less than 30 gal/min.

nected to a water treatment unit on the water circulation loop. The pulsed-power system controls biological activity and eliminates scaling without the use of water treatment chemicals, which are prohibited under California state law.

Before the pulsed-power units were installed in 2002, the water in each cooler was dumped daily, and the total discharge water, or blowdown, was more than 80 gal/min. With the chemical-free water treatment systems, blowdown has been reduced to less than 30 gal/min, and using them allows the plant to satisfy California's peak energy demand while providing energy savings.

Saving Water from the Ground Up

Christopher Ranch grows, packs and ships more than 60



The chemical-free water treatment system at Christopher Ranch has reduced daily average water use from 6,000 to 760 gal.

million lb of garlic each year. Headquartered in Gilroy, Calif., the "Garlic Capital of the World," the organization maintains wholesale distribution warehouses in Los Angeles, Chicago, New Jersey and Florida.

A progressive company, Christopher Ranch continually looks for ways to improve its farming methods and customer service. For example, 80 percent of its crops are on drip irrigation, which saves more than 2 million gal of water per day compared to overhead irrigation.

With an eye toward controlling scale and corrosion while reducing bacteria populations in the process water cooling tower, Christopher Ranch installed the chemical-free water treatment system. Prior to installation of the pulsed-power systems, chemical control was used, and scale had built up considerably. Within several months of instituting chemical-free treatment, scale diminished and the water turned from cloudy to clear. The change to pulsed-power water treatment also allowed Christopher Ranch to satisfy its desire to conserve water. The cooling tower now uses more than seven times less water, with the average daily water use dropping from 6,000 gal to 760 gal.

Treating Water without Chemicals

Schick, owned by Energizer, provides health-care and consumer products. At its 435,000 ft² plant in Milford, Conn., the company employs 900 workers and operates 24/7 making shaving products, including safety razors and razor blades. Raw materials include stainless steels, plastics and specialized protective and lubricant coatings. The razor-blade manufacturing processes include machining, heat treating, grinding, cleaning, vacuum vapor deposition

Chemical-Free Water Treatment Alternative

Pulsed-power technology controls biological growth, corrosion and scale in process cooling systems using a tried-and-true technology: the laws of physics.

Bacteria Control. Pulsed-power devices impart pulsed, high-frequency electrical energy into flowing water by inducing time-varying, pulsed electric fields 2,400 times per second. Pulsing an electric field in this way generates low-frequency, non-ionizing electromagnetic radiation. This radiation has a much lower frequency than microwave radiation (even lower than radio waves) but has a demonstrable effect on microorganisms. In a typical cooling tower setup, each bacterium experiences more than 20,000 pulses. The damage is sufficient to inhibit reproduction but not sterilize the system. The bacteria can recover in a few days, but they remain inactive while they are recirculating through the pulsed-power system. Total bacteria counts under pulsed-power control typically average less than 1,000 colony-forming units per milliliter.

Corrosion Control. In corrosion control applications, pulsed-power technology offers an advantage over chemical treatment with respect to copper. While copper is resistant to most domestic waters, it is subject to pitting attack by either microbial growth or high levels of oxidizing biocides (chlorine, bromine). Typical chemical regimes use a triazole as a copper corrosion inhibitor to protect the copper from the oxidizing biocide. Triazoles form a protective film on the copper surface and protect the underlying metal. However, triazoles are attacked by oxidizing biocides and, if they are at too low a level, can actually exacerbate localized galvanic attack by only partially covering the metal. A pulsed-power system eliminates these sources of corrosion while maintaining biological control without oxidizing biocides.

Scale Control. When calcium carbonate (limestone) and other dissolved minerals are concentrated through evaporation, they reach the level of saturation. Saturation is the level of concentration above which the water can hold no more minerals. At saturation, the minerals must precipitate out as a solid, using a surface as a starting point (i.e., heterogeneous nucleation).

Pulsed-power technology makes tiny suspended dust particles alternative sites for mineral precipitation through heterogeneous nucleation by removing the particles' surface charge. The dust particles become coated with the solid mineral material, thus acting as a relief valve for over-concentration of minerals (super-saturation). The dust particles are the preferred sites for precipitation over equipment surfaces for two reasons. First, the dust particles are so plentiful that minerals encounter them before they encounter the equipment surfaces. Second, the suspended particles travel with the flowing water and therefore do not have to overcome relative velocity, as they would between an equipment surface and flowing water. The mineral-coated powder produced by the pulsed-power system is harmless and non-sticking.

and coating operations.

Over the past decade, Schick's Milford facility has systematically eliminated the use of conditioning chemicals in process cooling and heating water by installing the pulsed-power water treatment system. This transfer of technology from chemicals to electrical pulsed-power has eliminated chemical costs, associated management costs, employee exposure to hazardous chemicals, potential company liabilities, and exposure to regulatory actions, all while achieving improved profitability, a cleaner environment, and a safer and healthier workplace.

Schick's first chemical-free water treatment unit was installed on a cooling tower system in May 1994 by replacing a length of 6" dia. recirculating pipe. The results were favorable from a number of scientific, engineering, environmental and economic perspectives. Employees were pleased with the system because it eliminated the need to



Schick has installed more than 20 chemical-free, pulsed-power water treatment units on all of its cooling tower systems.

work with several strong chemicals and the need for personal protective equipment. For this first unit alone, the financial analysis calculated a payback of less than one year.

Schick has since installed more than 20 additional pulsed-power units on its cooling tower systems. All cooling systems are operating smoothly with the electrical, pulsed-

power water treatment units. Schick also has installed these units on all of its boilers, thereby totally eliminating the use of all water-conditioning chemicals at the facility. The company reported that a boiler inspection showed clean tubes and satisfied the insurance company, which has strict requirements for boiler upkeep.

Chemical-free, pulsed-power water treatment is allowing numerous process cooling facilities to save water and energy. With the environmental and economic advantages provided by the pulsed-power technology, companies can improve their competitive edge into the future. **PCE**

For more information...

From Clearwater Systems Corp.
Call (860) 767-0850.
Email jja@clearwater-dolphin.com.
Visit www.clearwater-dolphin.com.

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The Process Cooling Water Angel

*From wineries to food processing,
from electronics to chemicals,
from power plants to plastics,
the chemical-free Dolphin System™
treats process cooling water right.*

- Superior Performance
- Environmentally Responsible
- Water and Energy Savings

The Dolphin Series 3000 helps you:

- Protect your equipment.
- Achieve impressive results.
- Reduce your environmental footprint.



(Above Photo: Dolphin Water Treatment System Installation at a California Winery)



Clearwater Systems Corporation

145 Dennison Road • P.O. Box 463, Essex, CT 06426
860-767-0850 • www.clearwater-dolphin.com