# Pulse-Powered Chemical-Free Water Treatment

by
ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers

# ASHRAE GreenTip Nr. 14

## Pulse-Powered Chemical-Free Water Treatment

### TECHNOLOGY DESCRIPTION

Pulse-powered physical water treatment uses pulsed, electric fields (a technology developed by the food industry for pasteurization) to control scaling, biological growth, and corrosion. This chemical-free approach to water treatment eliminates environmental and health-and-safety issues associated with water treatment chemicals.

Pulse-powered systems do not require pumps or chemical tanks. Pulsepowered systems tend to be forgiving of operational upsets and promote cooling tower operation at higher cycles of concentration (therefore, less blowdown and less water usage) than standard chemical treatment. Independent studies have shown not only that the method is effective for cooling towers but that the performance of pulsepowered systems is superior to standard chemical treatment in biological control and water usage. The performance results of pulse-powered technology for chemicalfree water treatment, as documented by various independent evaluations, support the objectives of green buildings and have earned LEED points for certification in a number of projects.

### WHEN/WHERE IT'S APPLICABLE

Pulse-powered technology is applicable on the recirculating lines of cooling towers, chillers, heat exchangers, boilers, evaporative condensers, fluid coolers, and fountains.

The technology produces a pulsed, time-varying, induced electric field inside a PVC pipe that is fit into the recirculating water system. The electric signal changes the way minerals in the water precipitate, totally avoiding hard-lime scale by insteadproducing a non-adherent mineral powder in the bulk wate r. The powder is readily filterable and easily removed. Bacteria are encapsulated into this mineral power and cannot reproduce, thereby resulting in low bacteria populations. The water chemistry maintained by pulse-powered technology is noncorrosive, operating at the saturation point of calcium carbonate (a cathodic corrosion-inhibiting environment).

The low bacteria count and reduction or elimination of biofilm reduces concern about microbial influenced corrosion. The absence of aggressive oxidizing biocides eliminates the risk of other forms of corrosion.

### PROS AND CONS

#### Pro

1. The potential for lower bacterial contamination while providing scale and corrosion control.
2. Lower energy and water use than in traditional chemical treatment.
3. Blowdown water is environmentally benign and recyclable.
4. Life-cycle cost savings compared to chemical treatment.
5. Reduction or elimination of biofilm.
6. Removes health and safety concerns about handling chemicals.
7. Eliminates the environmental impact of blowdown, air emissions, and drift from toxic chemicals.

#### Con

1. It does not work effectively on very soft or distilled water, since the technology is based on changing the way minerals in the water precipitate.
2. Water with high chloride or silica content may limit the cycles of concentration obtainable to ensure optimum water savings since the technology operates at the saturation point of calcium carbonate.
3. Energy usage is still required to operate.

## KEY ELEMENTS OF COST

The following economic factors list the various cost elements associated with traditional chemical treatment that are avoided with chemical-free water treatment.
This is a general assessment of what might be likely, but it may not be accurate in all situations. There is no substitute for a detailed cost analysis as part of the design process.

- *Direct Cost of Chemicals.* This item is the easiest to see and is sometimes considered the only cost. For cooling towers in the US, this direct cost usually runs between $8.00 and $20.00 per ton of cooling per year.
- *Water Softener.* Water softeners have direct additional costs for salt, media, equipment depreciation, maintenance, and direct labor.
- *OSHA and General Environmental Requirements.* Many chemicals used to treat water systems are OSHA-listed hazardous materials. Employees in this field are required to have documented, annual training on what to do in the event of a chemical release or otherwise exposed contamination.
- *General Handling Issues.* Chemical tanks, barrels, salt bags, etc., take space. A typical chemical station requires 100 ft (9.3 m) of space.
- *Equipment Maintenance.* Lower overall maintenance for the systems as a whole may be possible.
- *Water Savings.* Cooling towers are often a facility's largest consumer of water. Most chemically controlled cooling towers operate at two to four cycles of concentration. Cycles of concentration can often be changed to six to eight cycles with chemical-free technology, with an annual reduction in water usage costs and the associated environmental impacts.
- *Energy Savings.* Energy is required to operate the pulse-powered system, but overall energy usage can be lower. The reduction or elimination of biofilm (a slime layer in a cooling tower) results in energy savings versus chemical treatment due to improved heat transfer. Biofilm has a heat transfer resistance four times that of scale and is also the breeding ground for *Legionella* amplification. Preventing this amplification thus saves costs.

## SOURCES OF FURTHER INFORMATION


- Bisbee, D. 2003. *Pulse-Power Water Treatment Systems for Cooling Towers*.
- Energy Efficiency & Customer Research & Development, Sacramento
- Municipal Utility District, November 10, 2003.
- *Codes and Standards Enhancement Report, Code Change Proposal for Cooling*
- *Towers.* Pacific Gas and Electric, April 8, 2002.
- HPAC. 2004. Innovative grocery store seeks LEED certification. *HPAC Engineering* 27:31.
- Torcellini, P.A., N. Long, and R. Judkoff. 2004. Consumptive water use for U.S.
- power production. *ASHRAE Transactions* 110(1):96–100.
- Trane. 2005. *Trane Installation, Operation, and Maintenance Manual: Series R®*
- *Air-Cooled Rotary Liquid Chillers*, RTAA-SVX01A-EN. Lacrosse, WI: Trane Company. www.trane.com/Commercial/Equipment/PDF/3/RTAA-SVX01AEN.pdf


*Source: www.ashrae.org
ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers
Newsletter: http://www.ashrae.org/publications/page/573