

Physical Water Treatment of Cooling Tower Water – Has it's Time Finally Come?

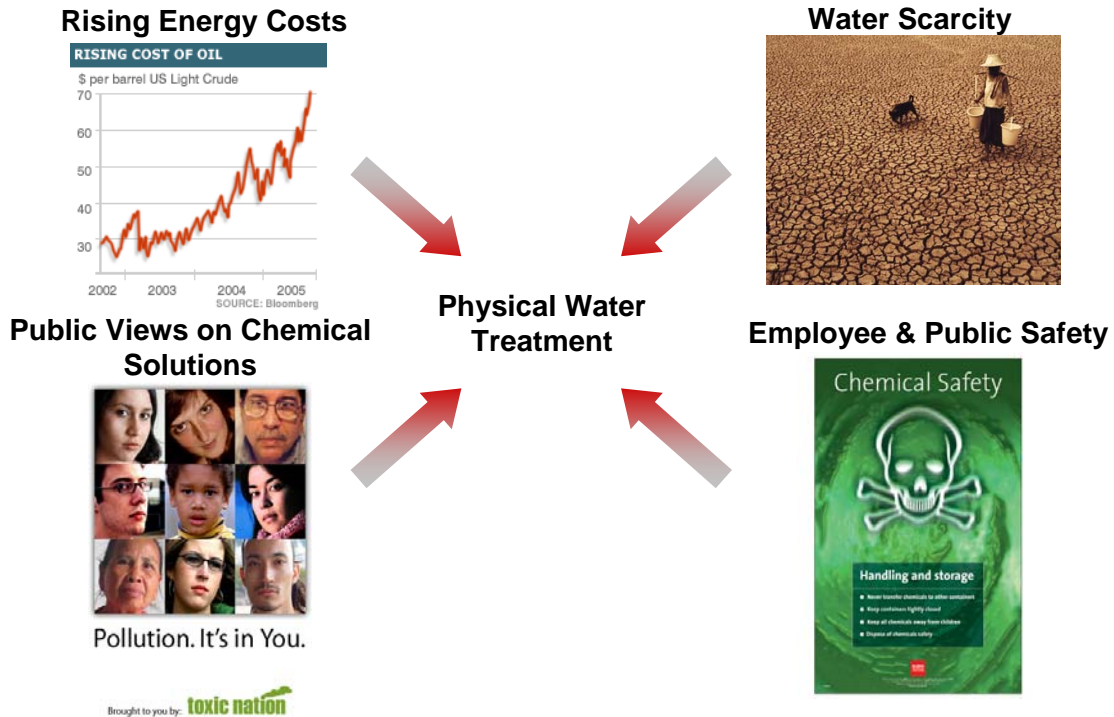
By Don Toporowski, P. Eng., Vice-President Sales - EnviroTower Inc.
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Recently, there has been a resurgence of interest and adoption of technologies that treat cooling tower water without the use of chemicals. The reasons are simple, and the trend is clear:

- Facility managers are increasingly dissatisfied with the results that they are getting with chemical treatment
- Facility owners and operators are under constant pressure to find new ways to reduce operating costs
- Leading corporate and public organizations are increasingly concerned about the impact their facilities are having on the environment and the community

What is driving the resurgence in Physical Water Treatment?

Macro trends in the marketplace are forcing commercial and industrial cooling tower owners and operators to look for new solutions to reduce energy and water consumption. Increased environmental pressures and growing dissatisfaction with existing chemical solutions is forcing companies to look for non-chemical approaches.



(i) Rising Energy Costs

Cooling system operation represents approximately 12 percent of a commercial building's operating costs.¹ With rising energy prices, the spotlight is on more efficient HVAC. A critical component of efficient cooling system operation is water treatment, as poor water treatment can quickly reduce operating efficiency.

(ii) Water Scarcity

Next to agriculture, cooling towers use more water than any other application in North America. Physical (or non-chemical) water treatment methods can significantly reduce water consumption, and more importantly, discharged water can be recycled for various 'grey' water applications, like irrigation, as it is non-toxic.

(iii) Environmental

Mandatory government regulations and self imposed or voluntary environmental regulations are driving the demand for environmentally friendly water treatment. For example, some municipalities require discharge water to be non-toxic. Environmental standards groups such as LEED are encouraging facility owners to implement changes that positively impact the environment and the bottom-line. Corporate Boards have also become a catalyst for environmental change.

(iv) Employee & Public Safety

Facility owners and managers are increasingly aware of the safety and liability risks associated with the storage and handling of water treatment chemicals on-site. Senior executives are also concerned about the safety of their cooling systems with the general public, in particular whether they have demonstrated due diligence with respect to controlling Legionella.

Who is adopting it?

Industry studies including a recent one titled *Independent Assessment of the Energy Savings, Environmental Improvements and Water Conservation of Emerging Non-Chemical Water Treatment Technologies*, by California Energy Commission in 2005, tell us a little more about the trend to physical water treatment technologies.

Adopters of physical water treatment technologies are not novices in water treatment. Most often, they report having used chemicals for water treatment their entire career. But they also report routine frustration by the inconsistencies of effectiveness of traditional chemical treatment across their portfolios or over time. Principal applications remain in cooling towers and evaporative condensers where savings are most substantial and paybacks best.

¹ Energy Consumption Characteristics of Commercial Building HVAC Systems, prepared for US Department of Energy, April, 2001.

Why are they switching?

Adopters of physical water treatment are doing so usually for either environmental or economic reasons, but most often report that they switched for *both* reasons in combination. Other users cite health and safety, particularly around the handling of chemicals by cooling tower maintenance staff, as a driver. Finally many users state dissatisfaction with the high maintenance costs related to cleaning their chillers and towers as a driver for the switch.

Concerns about the effectiveness of chemicals in the control of Legionella is another driver, particularly for hospitals and public sector facilities where the central focus is on public health and safety. The US Department of Labor attributes 25,000 cases of Legionnaire's Disease per year in US and 4,000 deaths annually to Legionella². The most worrisome source of this disease is cooling towers. Naturally, senior executives are concerned about whether their staff have demonstrated due diligence with respect to controlling Legionella. A lack of due diligence carries grave consequences. The most recent major outbreak in a nursing home in Toronto, Canada in October 2005 produced 21 deaths and 127 infections half of which were among staff and visitors not just among vulnerable, older, or sick residents.³ The ensuing \$600 Million class action lawsuit is making all tower operators take a deep breath and consider the effectiveness and liability associated with their maintenance and operation methods.

But does it make sense to the bottom-line?

While the environmental and health and safety benefits are compelling, facility owners and managers are responsible for implementing financially sound solutions in their operations. Physical water conditioning provides operators with a very fast payback as well as longer term savings and equipment life benefits.

Paybacks in physical water treatment applications are consistently below three years and often below one year in southern or hot climates with high duty cycles.

1) Increased Operating Efficiency

By eliminating scale and fouling throughout the system, operating efficiency is typically improved 15-30%. Less scale and fouling means improved heat transfer, increased air circulation in the un-clogged tower fill, and lower condenser head pressures since tube diameters are not reduced through scale build-up. In a detailed 2000 ASHRAE Study by Dr. Young Cho, of Drexel University, Dr. Cho wrote "...however, even a good water management program does not totally eliminate scaling. Minimum levels of even soft scale accumulation on condenser tubes will greatly reduce the chiller performance and subsequently increase the annual energy expense."⁴ He went on to demonstrate in his study that energy savings using a physical water conditioner over chemical treatment can

² http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html#app_iii:7_1

³ www.ctv.ca/servlet/ArticleNews/story/CTVNews/20051025/legionnaires_lawsuit_051024/20051026

⁴ ASHRAE Paper SE-99-3-1, *An Innovative Electronic Descaling Technology for Scale Prevention in a Chiller*. by Professor Young I. Cho Ph.D. and William Taylor Mgr. Building Systems - Drexel University Philadelphia Pa

provide savings of up to 32%. With further field tests by utilities verifying substantial energy savings, a number of North American utilities are now offering incentives for physical water treatment technologies because of the measurable energy they save.

2) Eliminate Traditional Chemical Treatment Program

Non-chemical treatment methods replace the existing chemical treatment program eliminating chemical costs and time consuming servicing and testing associated with them. Non-chemical treatment methods require minimal maintenance and can be managed by in-house staff, even those with no water treatment experience.

3) Conserve Water

Water consumption can be reduced by up to 20% by increasing the cycles of concentration in the cooling system.⁵ This is possible as physical water treatment methods reduce Total Dissolved Solids (TDS) in the water enabling a greater number of cycles of concentration to occur before blowdown. Additionally, the quality of the water exiting the system provides many opportunities for total water recycling. Field test verifications by some water utilities have led them to offer incentives for operators who install physical water treatment systems.

4) Extend Equipment Life

Equipment life is directly proportional to the rate of corrosion in the system. Effective physical water treatment methods eliminate the two major causes of corrosion. They kill and removes all bio-fouling, the primary cause of corrosion, and negate the effects of galvanic action to reduce corrosion. Additionally, zinc saturation provided by some systems further protects galvanized surfaces.

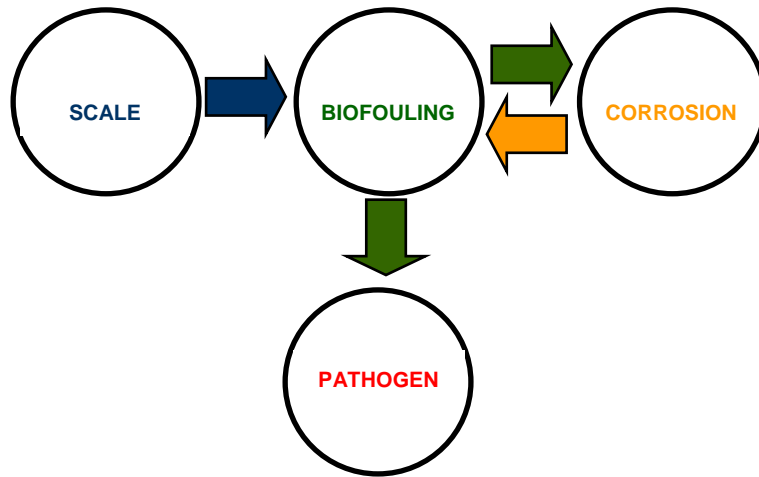
So if it's so good, why hasn't it taken off sooner?

Research began on physical water treatment devices over 50 years ago with many attempts all over the world to unlock the secret to successful treatment of cooling tower water, the most complicated of water treatment tasks in most plants. A history of failures of early devices left owners with little confidence in this alternative. These early devices typically failed due to design and/or application. Most designs were incapable of ever precipitating satisfactory levels of calcium carbonate in the water in order to create a descaling and corrosion protection effect, while others worked for only a short period of time. Today, there are very few effective devices, and some of those that are considered effective for descaling, like pulsed electromagnetic devices, will cause increases in corrosion. Physical water conditioners for the purpose of scale protection have used many different technologies including:

- Electrostatic-non electric
- Fixed Permanent Magnet
- Insulated High Voltage Electrode
- Dissimilar Exposed Metal
- Pulsed Electromagnetic
- Vortex-Cavitation

⁵ EnviroTower estimate.

Overall, past solutions tended to be only effective against scale and still required the addition of anti-corrosion chemicals and biocides, making them only a partial solution. In a typical cooling tower, we find that water quality issues are inter-related and complex to treat regardless of the method of treatment. Any water treatment solution must control all these factors on a continuous basis adjusting to the constantly changing conditions in the cooling system environment.



Recent Advances in Technology

Developments in Canada with the National Research Council in combination with EnviroTower have shown the combination of Iodine and Zinc in trace quantities to provide a complete and exceedingly reliable solution. Patents on a system which include this development have today allowed the financing and marketing of a revolutionary technology in physical water treatment that includes these two minerals. Attempts to use these two minerals in cooling towers in combination with chemicals or physical water treatment devices failed in the past because the systems could not be reliably kept sufficiently clean. With its superior physical water conditioner and just trace amounts of these minerals, EnviroTower is able to maintain water quality at optimum levels. Since the 1940's, Iodine has been used as a reliable disinfectant even killing Legionella up to 99.99999%⁶. In Canadian research conducted over the last ten years, Iodine in trace quantities has been proven to be effective as a biocide, particularly at the naturally elevated pH levels found in cooling towers.

A complete physical water treatment system has the ability to eliminate old and new scale, control biological fouling, minimize corrosion throughout the cooling system and provide maximum protection available against Legionella.

⁶ Sanden, G.N; Fields, B.S. et al.; "Bactericidal Activities of Tri- and Penta-iodinated Resins Against Legionella Pneumophila" Wat. Res., Vol. 26, No. 3 pp 365-370 (1992)

Summary and Conclusions.

It is quite apparent that macro forces and financial benefits are driving the market towards physical water treatment solutions for cooling towers. Increasing regulations and voluntary restrictions on discharges by corporations are accelerating the switch to more environmentally friendly alternatives. Careful monitoring and successful verifications of the technologies by power and water utilities and some of the largest end users are only increasing the credibility and adoption rate of physical water treatment technologies. It seems that it is simply a matter of time before you will see non-chemical treatment in the cooling tower nearest you.

About the Author.

Don Toporowski, P. Eng
V.P. Sales EnviroTower Inc.
don.toporowski@envirotower.com
416 722-2007
www.envirotower.com

Don has spent 20 years serving plant and building managers across North America. He is an expert in emerging technologies for buildings and in the commercialization of technologies related to energy conservation. He has helped facility engineers and operators successfully implement new technologies and systems that have assisted them in their goals of lowering operating costs and increasing the competitiveness of their operations. He has led numerous companies including GE, Motorola, and 3M in successful launches of new technical products and services into the facilities market. Don is a Mechanical Engineer and a member of the Professional Engineers of Ontario.