



Before installation of the new system, the distribution deck had visible live green algae.

Safe & Green Legionella Prevention

By Beth Boeh

One of the largest and most well-respected teaching hospitals in Illinois is also home to a central power plant with 7,000 tons of cooling tower capacity and a 100,000-gal central chilled water loop. When newly issued corporate responsibility guidelines encouraged sustainability and green practices at its facilities, the hospital sought expertise to streamline its efforts.

Onsite generation provides disinfection for Illinois hospital

An environmentally focused water and wastewater consulting firm would better understand the full range of technologies available to meet the hospital's sustainability goals and to provide programs that would reduce operating costs with minimal capital investment. The hospital contracted Earthwise Environmental to identify potential water and energy conservation management opportunities throughout its facilities, with the goal of reducing water and energy footprints. A site evaluation was conducted to consider ways to improve efficiency, extend equipment life, reduce chemical consumption and provide remote system performance monitoring.

Bacteria Concerns

The discovery of positive *Legionella* counts in the hospital's cooling tower system required immediate intervention. An engineering survey and inspection found leaking chemical feed stations and insufficient biocide feeds, as well as the absence of a proper *Legionella* control program.

When *Legionella pneumophila* or other *Legionella* species are introduced to a host as an aerosol, a type of pneumonia, legionellosis, can result. A severe form of legionellosis is known as Legionnaires' disease, a term coined in 1976 when an outbreak of pneumonia occurred among attendees of an American Legion convention at the Bellevue-Stratford Hotel in Philadelphia.

Legionella pneumophila is a ubiquitous aquatic organism that thrives in warm environments (32°C to 45°C) and causes more than 90% of Legionnaires' disease cases in the U.S. Cooling towers, showers, spas, pools, faucets and potable water systems that circulate contaminated water are capable of producing a potentially lethal aerosol.

Disinfection Solution

Committed to providing its clients with safe, environmentally beneficial technologies, Earthwise Environmental installed a MIOX AE-4 onsite disinfection system in July 2011 to replace a

12.5% bulk liquid sodium hypochlorite system for the 3,000-ton cooling tower in the hospital's neurosurgery center. Located near both a diesel generator and kitchen exhaust fan, the cooling tower was experiencing excessive biofouling from fats, oils and greases. A regular cleaning regimen required several biocides, including bleach, DBNPA and a specific algaecide, along with frequent manual brushing of the outer fill and upper distribution decks by hospital personnel.

Onsite Generation Process

Using an electrolytic process that generates disinfectant by passing a high amount of electrical current through a salt and water mixture, MIOX systems produce a mixed-oxidant solution (MOS)—a dilute bleach solution of 0.4% hypochlorite and related oxidants that reduces or removes biofilm, reduces algae loading and demonstrates a better free available chlorine (FAC) residual for maintaining cooling tower disinfection.

Traditional chlorine-based disinfection methods can pose a variety of safety concerns to the operator. Commonly used industrial-strength sodium hypochlorite (bleach) is caustic at a standard 12.5% solution.

Onsite generation systems use only water and salt and produce nontoxic, noncaustic oxidant solutions with a chlorine content that typically contains less than 0.8% FAC. These systems typically face less oversight from state health agencies, require less safety training for operators and have fewer insurance liability issues.

In addition, onsite generation is a more sustainable option compared to traditional chlorination methods. Transporting salt instead of chemicals to the hospital reduces carbon emissions: It can take more than four deliveries of 12.5% sodium hypochlorite solution to produce the same amount



The onsite disinfection system produces a mixed-oxidant solution to reduce biofilm and algae.

Table 1. Comparison of Effectiveness of Disinfection Methods

Microorganism	Initial Microorganism Concentration	Mixed Oxidants (2 mg/L)	NaOCl (2 mg/L)
<i>Legionella pneumophila</i>	1 x 10 ⁵	0 CFU/mL	> 2 CFU/mL
<i>Pseudomonas aeruginosa</i>	1 x 10 ⁵	0 CFU/mL	1,200 CFU/mL

Source: Larry Barton, Ph.D., University of New Mexico, "Disinfection of Simulated Cooling Tower Water," March 4, 1996.



The onsite generation system eliminated visible algae from the distribution deck.

of chlorine as one delivery of salt. Reducing transportation requirements reduces the carbon footprint of the hospital because less fossil fuel is needed to supply the plant with disinfectant. Onsite generation also eliminates the waste of empty chemical containers.

Effectiveness on *Legionella*

Legionella, often found in cooling towers and HVAC systems, associates with biofilm, a gelatinous layer consisting of microbial cells, the polysaccharide biopolymer they produce and debris extracted from the circulating water. The films continuously erode and disperse through the water system during normal operation, increasing the risk of inhaling a sufficient number of the airborne bacteria that causes Legionnaires' disease.

Studies show that chlorine-based MOS is more effective at removing biofilm from water system hardware than hypochlorite (chlorine) alone. MOS strips the biofilm and its polysaccharide substrate while chlorine affects only the bacteria on the surface of the film. Complete removal of the film eliminates one of the breeding grounds of *Legionella* bacteria.

Legionella testing is routinely conducted by staff at the Illinois teaching hospital, and positive readings were taken on several occasions in 2010. Since the onsite disinfection system was installed in July 2011, no positive results have been noted.

The operating engineer observed that the cooling tower is visibly cleaner now and that the slime and live green algae are gone from the hot distribution decks. Storage and handling of hazardous chemical bleach have been eliminated, and the hospital's biocide program is more effective and efficient. *wqp*

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