Chicago Department of Public Health

Cooling Tower Best Practices to Reduce Risk of Legionella Growth

Why Legionella is important to control

Legionnaires' disease is a serious lung infection typically requiring hospitalization caused by *Legionella* bacteria. People can get sick with Legionnaires' disease when they breathe in mist or accidently swallow water into the lungs containing *Legionella* bacteria. These bacteria typically live naturally in fresh water and can grow exponentially under stagnant conditions in building water systems. Cooling towers, evaporative condensers and other wet cooling devices produce mist which can be contaminated with *Legionella*; when people breathe in this contaminated mist they can become ill. People with Legionnaires' disease experience breathing difficulties, with symptoms similar to pneumonia, 2-14 days after exposure. About 1 of every 10 people who contract Legionnaires' disease may die of the infection and illness is especially dangerous for seniors and the immunocompromised. Rates of Legionnaires' disease in Chicago (5.9 cases per 100,000) are typically greater than the national average (2.7 cases per 100,000). The largest outbreak in New York City and second largest U.S. community outbreak of Legionnaires' disease was linked to a cooling tower in August 2015, resulting in 138 people infected and 16 deaths.[1]

Why cooling towers can harbor and disperse Legionella

Cooling towers use water evaporation, producing ideal conditions for *Legionella* growth and introduction of bacteria into the air (i.e., aerosolization), if not properly maintained. The water in these systems is likely to have ideal temperature ranges for *Legionella* growth: 20°-50°C (68°-122°F). The evaporative processes can release the bacteria into the air, increasing the likelihood for worker/community exposure when these aerosols are inhaled. These systems use fans to move air through a recirculated water system resulting in water vapor emission even when drift eliminators are used. When these pieces of equipment spray water or generate aerosols, they can disperse *Legionella* over a wide area.

Best practices to control spread of *Legionella* - Operation, Inspection, Maintenance, Design and Cleaning

Operation

Operate and maintain cooling towers with the following guidelines in mind:

- Follow manufacturer recommendations for cleaning and disinfection prior to commissioning, before startup, when idling, and after shutdown.
- Operate cooling tower systems at the lowest possible water temperature, and below the most favorable *Legionella* growth range (77–113°F, 25–45°C), if possible.
- Automate anti-corrosion, anti-scale, and disinfectant addition and monitoring.
- Monitor water parameters, like disinfectant residual and pH, on a regular basis. Measurement frequency should be based on performance of the water management program or *Legionella* performance indicators for control.
- Flush low-flow pipe runs and dead legs at least weekly.
- Balance operating times among cooling towers to prevent stagnation when multiple cooling towers or cells exist.

- Implement automated blow down to maintain system water quality.
- Consider filtration to reduce the level of suspended solids in the cooling water based on system factors (e.g. cooling tower location, particle load).
- Monitor cooling towers for water service disruptions and develop plans with your water management team to respond accordingly.

Inspections/Maintenance

Visually inspect the cooling tower frequently to maintain the tower and its components in good working order:

- Ensure the tower and basin are free from biofilm, visible slime, dirt and debris.
- Defects in the components or their installation, which may lead to emission of excessive drift or spray, should be corrected.
- Inspection should also be performed on the outside of the unit for general cleanliness, leaks, or any evidence of dirt, debris, or organic matter.
- Pools of water or small droplets emanating from the tower may be a sign of excessive drift.
- The appearance of heavy deposits on the outside of the unit may be an indication of excessive water loss.
- Areas to inspect include: water treatment system, louvers, piping dead legs, cold water basins, crossflow hot water basin, counterflow spray system, eliminators and fill.

Design

To prevent *Legionella* growth and spreading, design water system options to:

- Equip water collection areas with drains and supply make-up water to reduce dissolved solids that facilitate *Legionella* growth.
- Keep sump water temperatures low.
- Install high-efficiency drift eliminators. Older systems can be retrofitted with newer, high-efficiency drift eliminators.
- Consider other design features that minimize water vapor releases. An enclosed system will prevent *Legionella* from becoming airborne if it grows in the system.
- Include design features that maximize internal component cleaning. For example, installing easy-access or easily disassembled components will simplify cleaning.

Cleaning

Preventing *Legionella* growth through cleaning will reduce the likelihood for exposure. Considerations for cleaning water systems in the workplace include:

- Cleaning and disinfecting cooling towers at least twice a year. Normally, this maintenance is performed before initial start-up when the cooling season begins and after shut-down in the fall. Systems with heavy biofouling or high *Legionella* levels in samples may require additional cleaning
- Cleaning and disinfecting systems that are out of service for an extended period of time.
- Cleaning and disinfecting new systems. Construction material residue can contribute to *Legionella* growth in new systems.

Monitoring *Legionella* in Cooling Water Systems -

Most professional and government agencies that have issued *Legionella* prevention position statements and guidelines do not recommend testing for *Legionella* bacteria on a routine basis. These reasons

derive from difficulties in interpreting *Legionella* test results and in using test results as a basis for control. Note the following aspects:

- *Legionella* may be "non-detectable" in bulk water samples collected on one day but can repopulate and be found within a few days. *Legionella* can be released from biofilms or from host life forms associated with these films. *Legionella* are reported to be capable of rapid recolonization of previously cleaned systems, especially if conducive conditions are present.
- Culture-based techniques used by testing labs to quantify *Legionella* have a 10 to 14 day turnaround for results. This period is too long for *Legionella* monitoring to serve as an effective tool for control.

Various studies have shown that some 40 to 60% of cooling towers tested contained *Legionella*. Therefore, it is best to assume that any given system can harbor the organism, and that routine, continuous microbiological control practices should be implemented to minimize the risk of *Legionella* amplification and associated disease. Testing for *Legionella* is recommended in the event of an outbreak (to identify potential sources of the organism) and to evaluate the effectiveness of disinfection procedures.

Legal consequences

Lawsuits have been filed against building owners and cooling tower maintenance companies for negligence due to Legionnaires' disease outbreaks in numerous states. Outbreaks due to cooling towers can also result in unfavorable press.

Reference

1. Fitzhenry, Robert et al. "Legionnaires' Disease Outbreaks and Cooling Towers, New York City, New York, USA." Emerging infectious diseases vol. 23,11 (2017): 1769–1776. doi:10.3201/eid2311.161584

Resources/Links

ASHRAE Standard and Guidance for managing Legionellosis risk with building water systems:
https://www.ashrae.org/technical-resources/standards-and-guidelines/guidance-on-reducing-the-risk-of-legionella

CDC Legionnaires' disease homepage:
https://www.cdc.gov/legionella/index.html

CDC guidance on controlling *Legionella* in cooling towers:
https://www.cdc.gov/legionella/downloads/control-toolkit-cooling-towers.pdf

CDPH Legionnaires' disease resources:
https://www.chicagohan.org/diseases-and-conditions/legionellosis

Recordkeeping

Records should be kept of measures and treatments, monitoring results and remedial work, including mechanical cooling tower cleaning, the frequency and amount of biocide addition, halogen residual levels, results of biomonitoring, and other significant aspects of the tower operation. If there are any complaints or safety, health or environmental audit findings regarding tower operations, they should be documented, as should any corrective actions taken. A records retention policy should be developed and followed.