COVID-19 and *Legionella* - Preparations to consider for Municipal and Building Potable Water Systems

by Tim Keane

Now stagnant potable water systems, in empty or partially empty buildings across the nation as a result of COVID-19, pose a high risk for growing waterborne pathogens, including Legionella. Without proper actions, this stagnant water will result in a significant amount of Legionnaires' disease outbreaks within 2 weeks to 9 months after buildings are put back into service post COVID-19. This document provides simple and effective actions buildings owners and municipal suppliers can take now to reduce risk created by these stagnant water conditions.

The target audiences for this document are government agencies, municipal water providers, professional organizations, buildings owners and operators as well as those who provide building engineering and maintenance services.

COVID-19 "stay-at-home" orders have resulted in commercial buildings across the country to close or operate at extremely low capacity. If the water systems in these buildings are not being properly managed, the water in these buildings has stagnated and has lost disinfectant residual. This provides a perfect environment for bacteria, including waterborne pathogens and hard to remove biofilm to grow. Additionally, where these idled buildings are clustered in heavy commercial districts there may be significant water aging issues in the municipal water distribution systems.[1]

According to CDC there are over 25,000 cases per year of Legionnaires' disease (LD) in the US and 80% of those cases are not diagnosed as LD. Many think LD outbreaks occur mostly in healthcare facilities. However, more Legionnaires' disease outbreaks occur in hotels than hospitals and nursing homes combined.[2]

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Potable water related Legionnaires' disease outbreaks typically do not occur in large clusters of illness but rather as very few cases, spread out over weeks or months. These sporadic cases of illness are frequently misdiagnosed as pneumonia and not identified as LD. However, potable water LD outbreaks associated with a significant event such as a water main break[3], a significant change in municipal water quality[4], or a serious storm[5] have resulted in outbreaks with a large amount of illness in a very short period of time. Almost all cases of LD result in hospitalization and as many as 10% of LD cases result in death.

In all cases this author has reviewed, when large potable water related LD outbreaks occurred in addition to a triggering event such as a water main issue, there was also;

1. No effective Legionella Risk Management plan in place,
2. Multiple, significant issues with the building potable water system design, operation and / or maintenance and
3. Storage type water heaters were not maintaining temperatures of 140°F as recommended by OSHA (1998)[8], ASHRAE (2000)[9] and CDC (2003).[10]

Example: Both Flint, MI and Quincy, IL, Legionnaires' disease outbreaks identified issues with delivery or maintenance of municipal water disinfectant levels to be associated with the building water system outbreaks.[4,5] The Quincy outbreak resulted in 58 cases of illness and 12 deaths with 54 of those cases occurring at the Quincy Veterans Home and the Flint LD outbreak resulted in 90 cases and 12 deaths with 51 cases associated with McLaren Hospital. As a result of the Quincy outbreak, Illinois changed state law in August of 2019 requiring 0.5 mg/L, free and 1.0 mg/L total chlorine in all parts of the municipal distribution system. These levels are higher than required by code and are required in all parts of the system. Some states require only that a residual is "detectable" a certain percentage of the time, resulting in some parts of the distribution system receiving little to no disinfectant residual.

Potential Issues with Municipal Water Supply to Investigate

Where a high number of COVID-19 related building shut downs are concentrated in a commercial area, there may be a significant impact on water aging and bacteria growth in the municipal water supply for that area. Therefore, building owners in an area with a high number of COVID-19 related shutdowns should communicate with their municipal water supplier prior to any building water use, including flushing, if the supplier has not already provided communications, and ask the following questions;

1. What is the expected normal disinfectant residual at your building?
   Municipal providers are required to maintain and monitor levels of disinfectant throughout the distribution system. In states where minimal disinfectant level is not required, some parts of the municipal water distribution system may routinely have no or very low disinfectant levels.
2. Will the municipal water provider be increasing disinfectant level during building startup timeframe post COVID-19 shutdown to minimize risks?
   This will inform building owners the level of any increased residual they can expect to observe at the point of entry to their building.
3. Will the municipal provider be flushing hydrants to remove standing water, solids and metals from the distribution mains and if so on what dates?
   When possible, building owners should schedule building water flushing after hydrant flushing to improve flushing results and minimize the likelihood that contaminants dislodged during mains flushing will enter the building.
4. What is expected temperature of water supply?
   Disinfectant level is the best method to measure removal of stagnant water. Water temperature may be used as an indicator of fresh water if residual disinfectant testing is not feasible. The target with flushing cold water is to have the same disinfectant level (and temperature) in the cold water plumbing within buildings as being identified in the municipal main.

5. Does the utility use chloramine as their secondary (distribution line) disinfectant? If yes;
   a. Will the municipal provider be temporarily switching to free chlorine for a burn out to remove nitrifying bacteria and, if so,
      i. when is the planned start and planned end date and
      ii. what level of free chlorine do they intend to use? This will inform building owners the level of disinfectant residual they can expect at the point of entry to their building.[15]

Building Water – Understanding the Risks

There are costs and risks associated with allowing a building potable water system to become stagnant. **One-time flushing alone will likely not bring a building water system, stagnant for some time, back to previous conditions.**

Greatest Risk: Central, Circulated Hot Water Systems

The central, circulated hot water system is well-known and well-documented to be the greatest risk for *Legionella* growth in the building potable water system. There are two reasons for this;

1. disinfectant residual will be destroyed much faster in hot water, typically there is no residual disinfectant in the hot water system and
2. even if hot water is generated and circulated at very hot temperatures (130 °F or above), the temperature in the uncirculated drop legs will always be stratified and consistently be at the best temperature for *Legionella* growth, between 85-110°F.

These issues can be addressed simply and inexpensively, greatly reducing risk for waterborne pathogens and costs to control them.

Take Action Now to control Bacteria & Biofilm

One simple solution is to avoid the problem.

- ✓ Don't allow the systems to become stagnant.
- ✓ Flush all potable water equipment (any equipment with water storage: softeners, tanks, etc.), and hot and cold fixtures at least once per week.

Flushing should be conducted at the highest safe velocity over the shortest period of time. Flushing should start nearest the point of entry to the building and the biggest pipes and progress along the path of flow finishing at the furthest away fixtures and the smallest pipes. The idea with flushing is to remove stagnant water from the piping and not to move stagnant water and bacteria from one point in the system to a point further downstream.

For more information on flushing see Legionella Risk Management, "Developing a Building Potable Water System Flushing Program".[15]

Cold Water

Cold water systems are uncirculated, water comes into the riser or header and only moves when used at a fixture. Effectively flushing a cold-water system requires displacing the volume of water in the risers or header by flushing the fixtures.

Central, Circulated Hot Water Systems (systems with a hot water return pump)

In buildings with no hot water use during COVID-19, turn off heat to the water heater and use the hot water return pump to circulate unheated cold water through the hot water system. Unlike the cold-water system, the circulating hot water loop can be centrally flushed at the hot water return either manually or automatically with a timer and a power operated ball valve. Water should be flushed from the hot water return pump discharge until disinfectant residual is near the level in the cold-water supply and should be repeated frequently enough to maintain a detectable residual at the hot water return. If the system has a storage tank and all the valves work, draining, air drying, and bypassing the tank may be recommended by the manufacturer for long term storage, but in this application dry storage is likely to be more of a problem than a benefit. Allowing the cold water to circulate through the tank would be simpler. This process addresses the two greatest risks associated with hot water, no disinfectant and temperature conducive to high rates of Legionella growth. With this water quality, flushing the system once a week will likely control bacteria whereas with heated water flushing even twice a week or more may not control the bacteria.

Building Hot Water Temperature Recommendations after COVID-19

Keep hot water hot!

Even if building water systems are flushed and disinfected after prolonged stagnant conditions, the risk for Legionella regrowth and rebound is significant. Once stagnant buildings are put back into operation, buildings with central, circulated hot water systems should be monitored and maintained to control Legionella.[16]

Healthcare facilities may be regulated by state law to maintain potable hot water temperatures at levels conducive to Legionella growth. This is not the case for hot water in most areas of hotels and other buildings. Many good hotels maintain hot water temperature at all sinks and showers above 120°F and as high as 130°F for customer satisfaction. As stated in Appendix N of UPC code 2021, maintaining temperature at all sinks and showers, between 120-130°F, results in a low risk for Legionella growth and a very low risk for scalding.

Also as stated in all good Legionella guidance documents, storage tank water heaters should maintain temperature greater than 140°F. In many major outbreaks including Flint and Quincy, heaters not set for >140°F were found to be a contributing factor to the outbreaks. Electronic master mixing valves have much better control +/- 2°F (differential 4°F) than mechanical master mixing valves which are at best are typically capable of +/- 7°F (differential 14°F). This better control range allows for maintaining hot water to the building at a safer range for Legionella control.

> Example: An electronic master mixing valve set for 125°F, the expected temperature range of 123°F to 127°F is well within control limits of 120°F to 130°F. A mechanical master mixing valve set for 125°F, the expected temperature range of 118°F to 132°F results in temperatures below and above desired limits.
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> In healthcare facilities trying not to exceed 120°F an electronic master mixing valve would be set for 118°F and a mechanical master mixing valve for 113°F. With an expected 5°F or greater temperature differential across the hot water system, if starting at 113°F at the heater outlet the result would be 108°F in many parts of the system.

Legionella growth rate is highest between 85°F to 110°F.

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