**Addressing High Water Age (Stagnation) in Low Occupancy Buildings**

**Background**

Whenever there is little or no occupancy in a building, issues and concerns typically arise surrounding water age in building water systems due to increased stagnation. These low-flow / no-flow conditions lead to accelerated biofilm formation. Biofilms are a group of microorganisms embedded in slime which adhere to a piping surface. These biofilms often harbor opportunistic premise plumbing pathogens (OPPP’s) which when released into the water system, can injure building occupants. This condition is further exacerbated by disinfectants not being circulated, and therefore not being able to effectively reach all portions of premise plumbing piping, especially building water fixtures, equipment, and points of use.

This guidance document attempts to offer practical suggestions and system re-commissioning steps building owners and operators may take to effectively manage biofilms and/or loss of disinfectants in these systems and equipment.

**Building Water Systems impacted by stagnation (increased water age)**

Water age is an important performance indicator to many utilities. Water age refers to the time it takes for water to travel from a water source to a point of use and is influenced by water demands throughout a building. As buildings experience vast changes in occupancy or shut downs due to the ongoing COVID-19 pandemic water age becomes an increased concern.

There are many locations within a building’s plumbing system where OPPP’s can grow and/or spread within buildings experiencing lowered use or occupancy. Those locations include (but are not limited to) the following:

* Hot and Cold Water Storage tanks
* Water Heaters
* Water Filters
* Electronic and Manual faucets
* Aerators
* Faucet flow restrictors
* Showerheads and hoses
* Eyewash stations / Emergency showers
* Ice Machines
* Swimming pools / Hot tubs / Spas
* Decorative Fountains
* Cooling Towers
* Misters / Atomizers / Humidifiers

**General Considerations for all building water systems**

If an existing and up-to-date Water Management Plan (WMP) is in place and addresses these issues and building systems, it should be referred to for guidance, and implemented to help control waterborne pathogens within the building. Although each building, and each low/no-flow condition is unique to each facility, the following practical steps may help reduce the potential for water system damage and waterborne pathogen proliferation:

* Maintain building HVAC systems online to maintain temperature and humidity control.
* If not required for HVAC system operation, the cooling tower, chillers, heat exchangers, and associated piping should be completely drained. Leaving the system filled with stagnant water can result in severe corrosion, biofouling problems, and contribute to the transmission of Legionnaires’ disease.
* If the cooling tower is required for HVAC system operation, specific treatment protocols may be required to help address [microbiological problems under] low load conditions. Although inhibitor requirements may be reduced under low load, microbiological control is more challenging. Do no discontinue water treatment if the tower is being operated.
* Drain decorative fountains, hot tubs, and pools completely unless approved treatment and monitoring protocols are maintained. A Legionnaires’ disease outbreak in 2019 which resulted in over 140 cases and 3 deaths was linked to a poorly maintained hot tub display.
* Disconnect the water supply lines to ice machines, coffee makers, water filters, and similar devices. Disinfect inlet lines and install new filters prior to start up.
* Maintain water heaters at their designated temperature set point (ideally at or above

120° F), and continue to operate installed hot water recirculation pumps (where equipped.)

* Flush all hot and cold water fixtures (showers, faucets, eyewash stations, etc.) at least weekly. Document the flushing schedule with log sheets. Routine flushing may mitigate the necessity of disinfecting the potable water system before the building is reoccupied.
* Periodically monitor the chlorine levels at the point of entry and locations throughout the building to ensure flushing provides adequate residuals. Simple test kits are available for chlorine testing.

Methods for limiting waterborne pathogen proliferation in building water systems include:

* Keeping the systems clean and free from sediment
* Controlling hot and cold water temperatures
* Minimizing water age (stagnation) by flushing and/or circulating
* Maintaining appropriate disinfectant residuals

**Specific considerations for each water system / device within a building**

Specific considerations for each of the various different building water systems include:

**Hot and Cold Water Storage Tanks**

Both hot and cold water storage tanks present a risk due to water sitting stagnant in the tank. It is important to keep cold water cold, and hot water hot. Storage tanks ideally should be insulated where the possibility of gaining or losing heat may result in temperatures within the ranges which support waterborne pathogen growth. If a building’s daily water usage no longer exceeds the volume of the tank, considerations should be made to treat the tank with chlorine. Ideally, water shouldn’t remain stagnant in a storage tank longer than 24 hours. If a building is expecting a long term shut down, it is recommended to drain, clean, and disinfect domestic water storage tanks.

**Domestic Water Heaters**

All hot water heaters and hot water storage tanks should be maintained at their designated set point temperatures (ideally at or above 120° F.) Water heater and tank temperatures should be recorded daily. It is important to alternate redundant water heaters as frequently as possible to reduce water stagnation. Facilities should ensure all hot water return pumps are operational and set to circulate 24/7 in order to assist with maintaining water flow. Water heaters and storage tanks should be flushed from their lowest points at least once weekly to remove sediment and scale.

**Point of Use Water Filters**

When low occupancy is expected to last for an extended period of time, it is recommended to disconnect the water supplies and shut off devices such as ice machines, washers, coffee makers, soda machines, etc. Due to the decreased demand, water in these devices and their supply lines will become stagnant and are likely to breed bacteria if not disconnected and drained. All inlet lines to devices should be disinfected, and new POU filters should be installed prior to these devices being placed back into routine service.

**Electronic and Manual Faucets**

Cold and hot water temperatures at faucets and sinks should be routinely recorded at several points in the building. The temperatures at distal points of use should be no more than 10° F warmer than the cold water entering the building at the point of entry, or 10° F colder than the discharge temperature of the domestic hot water heaters. Any temperature deviations exceeding this may indicate that additional piping insulation is required on domestic hot or cold water risers.

All hot and cold water fixtures should be flushed at least weekly. The flushing time at each fixture should be over two minutes after final temperatures (hot and cold) have stabilized. The flushing schedule should be documented on log sheets. Routine flushing may mitigate the necessity of disinfecting the potable water system before the building is reoccupied.

If routine flushing of fixtures during extended periods of low or no occupancy is not operationally possible, the entire domestic water system should be disinfected with at least 2 – 4 ppm of free chlorine residual, no greater than 3 weeks before substantial occupancy.

**Aerators**

All faucet aerators should be disinfected one of two ways as follows:

1. In place by cycling the faucet on while entire domestic water disinfection with at least 2 – 4 ppm of chlorine is underway.
2. By removing the aerator, and manually disinfecting it with chlorine bleach before reinstalling it back onto the fixture.

**Faucet flow restrictors**

All faucet flow restrictors should be disinfected one of two ways as follows:

1. In place by cycling the faucet on while entire domestic water disinfection with at least 2 – 4 ppm of chlorine is underway.
2. By removing the flow restrictor, and manually disinfecting it with chlorine bleach before reinstalling it back onto the fixture.

**Showerheads and hoses**

All showerheads and hoses should be disinfected one of two ways as follows:

1. In place by cycling the shower on while the entire domestic water disinfection with at least 2 – 4 ppm of chlorine is underway.
2. By removing the showerhead, shower wand and hose assembly, and manually disinfecting it with chlorine bleach before reinstalling it back onto the fixture.

**Eyewash stations and Emergency showers**

All eyewash stations should be flushed weekly and safety showers should be flushed monthly. The time should meet or exceed the duration recommended by the manufacturer, ANSI, and OSHA. Dates of flushing as well as the duration in all eyewash stations and safety showers should be logged.

**Ice Machines**

When low occupancy is expected to last for an extended period of time, it is recommended to disconnect the water supplies and shut off all ice machines. Due to the decreased demand, water in these devices and their supply lines will become stagnant and are likely to breed bacteria if not disconnected and drained. All inlet lines to devices should be disinfected, and new POU filters should be installed prior to these devices being placed back into routine service. A complete cleaning, sanitization, and descaling should be performed on each ice machine before placing these back in service. Upon start up, the first batch/load of ice should be dumped and discarded before resuming ice making for human consumption.

**Swimming pools / Hot tubs / Whirlpool Spas**

All swimming pools, hot tubs, and whirlpool spas must be operated and maintained in accordance with manufacturer’s recommendations, state & local licensure and health permitting processes, and the CDC Model Aquatic Health Code. If one of these devices will be out of service for greater than three days, it should be completely drained unless approved treatment and monitoring protocols are maintained. All systems should be properly cleaned and disinfected prior to placing back into use.

**Decorative Fountains**

All indoor and outdoor decorative fountains and man-made aesthetic fountains, waterfalls, cascades, etc., not in operation for 3 or more days must be drained, and all components cleaned and disinfected before start up as per ASHRAE 188-2018 7.4, and ASHRAE Guideline 12-2000.

**Cooling Towers**

All HVAC systems should remain in operation in order to maintain the temperature and humidity control within the respective building. As long as the HVAC system remains in operation, water treatment should be continued. While the corrosion inhibitor usage may decrease due to low load, correct and frequent microbiocide treatments will become more crucial and more challenging to control. It is important to get guidance and support from your water treatment provider when low load conditions arise.

Water should be circulated through any off-line cooling tower, chillers, heat exchangers, and condenser water piping to minimize stagnation and resultant biofilm formation. If a building does not require the HVAC system to be in operation during a decrease in building occupancy, all cooling towers, chillers, heat exchangers, and associated piping should be drained. Leaving the system filled with stagnant water can result in severe corrosion, biofouling problems, and contribute to the transmission of Legionnaires’ disease.

Shut down procedures should follow manufacturer instructions, and ASHRAE recommendations. Shut down procedures should be documented and include which biocides were used for any disinfections, along with their concentrations maintained, and the duration of use.

**Misters / Atomizers / Humidifiers**

All misters/atomizers/cold-water humidifiers must be cleaned, disinfected, and have their filters changed (where installed) before being placed back into service.

**Domestic Water Disinfectant Residuals**

In addition to device and system specific issues arising from stagnant water, the entire building may observe that disinfectant levels throughout the domestic cold and hot water systems are non-existent, or dramatically reduced, due to increased building water age. A lack of disinfectant will allow bacteria to grow and flourish within premise plumbing; the longer the water sits stagnant within the building, the more the disinfectant will degrade. Therefore, it is important to identify how and where domestic water chlorine levels are degrading within your building water systems.

Most Public Water Supplies disinfect domestic water at the water treatment plant with either chlorine or chloramine. It is important for a building to understand what disinfectant is being supplied to their water in order to know how to control and document the residuals throughout their building(s). If a facility is receiving chlorinated city water, treatment and remediation efforts should be based on FREE chlorine residuals. If a facility is receiving chloraminated city water, treatment and remediation efforts should be based on TOTAL chlorine residuals.

Chlorine levels at the point of entry, compared with various distal locations throughout the building should be periodically monitored to ensure that flushing efforts provide adequate disinfectant residuals. It is recommended to record at least five readings during each round of monitoring. These should be done at the incoming water supply, and at least two faucets, both hot and cold, one of which is located near the distal end of the building water system.

It is quite likely to find no detectable chlorine residual in the domestic hot water system, because chlorine dissipates in the heat. However, within the cold water, there should be no more than a 0.3 ppm decrease in distal versus incoming point of entry chlorine levels, otherwise building water system disinfection may be required in order to reestablish desired disinfectant levels within premise plumbing. This may be achieved by either short-term or long-term supplemental disinfection methods.

**Plumbing System Decommissioning requires Recommissioning before usage**

When low occupancy is expected to last for an extended period of time, the premise plumbing systems have, by default, become decommissioned. Before reoccupying the building, it is essential to recommission the building using plumbing disinfection methods described in plumbing codes, AWWA C651-14, and ASHRAE Standard 188, no greater than 3 weeks before substantial occupancy.

For additional information, and support addressing water stagnation issues in building water systems, building water disinfection, supplemental disinfection systems, or any other water management concerns, please contact your Chem-Aqua Water Risk Management Services Group for immediate assistance at: **1-866-209-3373.**