Background

Many organizations around the world, including KAUST, implemented a 'hibernation' of buildings facilities for a number of months to protect the health and well-being of communities during COVID-19.

These changes introduced a new variable to our drinking water network; widespread and sudden reduction in water flow and increased stagnation of water in hibernated facilities.

Under normal operating conditions drinking water systems have continuous flow. Despite KAUSTs high quality drinking water, Health, Safety and Environment (HSE), Utilities and Facilities Maintenance Department teams worked together to perform checks, over and above existing controls. This was to ensure public health was protected under altered operating conditions.

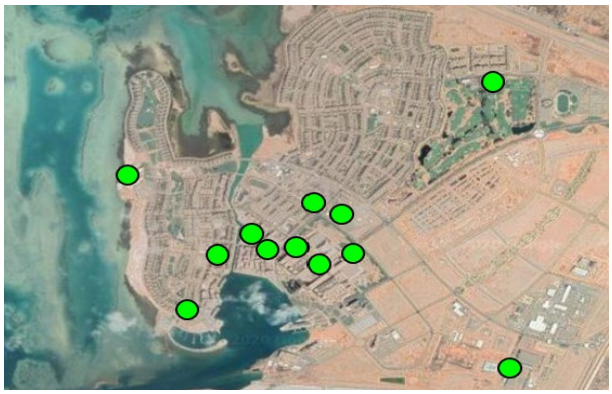
Drinking water was subjected to additional surveillance

Water Quality Monitoring

HSE undertakes routine surveillance for microbiological and chemical contaminants (refer to Technical Note No.3). A HSE Flushing Checklist (attached) was issued to operational teams to mitigate potential risks due to contaminant accumulation during hibernation.

Targeted water quality testing was undertaken on 3rd June 2020 at the utilities plant, campus, schools, diners, research buildings, apartments, retail outlets, recreation facilities and KAUST Health Analytes included, but were not limited to, E. coli, heterotrophic plate count, aluminum, antimony, arsenic, cadmium, copper, chromium, iron, lead, manganese, mercury, nickel, zinc, legionella, and disinfection by-products.

Out of 12 facilities tested, three locations were confirmed as having low levels of contaminants removed by flushing. Additional deep cleaning and preventative controls to ensure water quality is of a high standard were implemented prior to reopening.



Drinking water testing locations of hibernated and high risk facilities on 3 June 2020

Key hibernation learnings

Following hibernation of large tracts of KAUSTs drinking water network during facilities hibernation, the key learnings for future hibernations were:

1. No systemic water quality concerns were noted;
2. Downstream flushing protocols are essential to ensure re-sterilization of drinking water pipes and fittings;
3. As expected, levels of free chlorine/disinfection reduce over the hibernated period, this is resolved by local flushing and increasing central treatment free chlorine levels;
4. Metals may dissolve, particularly within building plumbing fixtures, this is resolved locally by tap flushing; and
5. Biofilms may form on end-user fittings, with some fittings requiring physically cleaning.

There is no need to buy bottled water for drinking. Safe, clean tap water is available at KAUST.

Based on existing knowledge and research there is no indication that SARS-CoV-2 can persist in drinking water[1]. Conventional water treatment methods such as use of chlorine for disinfection significantly reduces the risk of water related illnesses.

[1]WHO, Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19, Interim Guidance, 29 July 2020

Attachment – Example Flushing Checklist

HSE Facilities Reopening Checklist-Water Systems

Last Updated: June 2020

This checklist will assist operations ensure public health risks related to water systems are appropriately managed during reopening of facilities at KAUST

All Water Systems

- Flush building/water systems prior to use following the flushing protocol
- Ensure Hot Water Systems and Thermostatic Mixing Valves are at manufacturer recommended temperature to deactivate legionella

Stagnant water and low temperature water may allow legionella to multiply
E.g. Eyewashes, showers, greenhouses, buildings/houses/tanks, fountains

Drinking Water

- Flush all water taps and fountains prior to use
- Clean dispensers and replace old stagnant bottles with new
- Inspect sediment or cartridge filters, replace if necessary

Stagnant water loses sterility/disinfection potency and may host bacteria
E.g. Kitchen taps, drinking fountains, water dispensers, sediment filters

Recreational Water

- Inspect pool and circulation systems for debris, algae etc.
- Inspect all systems, conduct maintenance and cleaning of tiles, ladders etc. with pump running to ensure filtration.
- Balance chemicals, backwash, and recirculate for 24 hours. NOTE: if pool has not been fully maintained with records then super-chlorination is required as per faecal release procedure.

E.g. Public and private pools, dive pool

Water Systems Flushing Protocol

Intent of Flushing

Public health protection is a key responsibility for the operators of water systems. This protocol provides water safety guidance on flushing of facilities water systems to prevent hazards, such as microbiological or chemical contaminants, which may be present due to prolonged water stagnation or insufficient disinfection residual. Flushing involves opening taps or draining water systems on a regular frequency and letting the water run to remove water that has been standing in the interior pipes and/or the outlets.

Susceptible Water Systems

The scope of this flushing protocol includes water systems where human exposure via ingestion or inhalation is possible. This includes, but is not limited to, recirculated drinking water supplies, decorative fountains, bottled-water dispensers, drinking water fountains, shower heads, disused irrigation systems, hot water systems, storage tanks, ice machines. Special consideration shall be given to buildings hosting vulnerable populations (e.g. KAUST Health, daycares, schools, quarantine areas). It is important to note that risk of human exposure to water aerosols must be managed during the flushing process.

Flushing Method

There is no single method to cover all circumstances, however the overarching principle is the same – to move potentially contaminated water and ensure that water stagnation is avoided. Flushing along with physical cleaning are required to ensure biofilms/debris minimize risk of potential contaminants. The key flushing steps are as follows:

1. Begin by flushing outlets/taps furthest away from the water source. Pipework layouts vary, and where multiple building wings exist they all will require flushing;
2. Flush the tap second furthest away from the water source and continue in this manner until all taps have been flushed;
3. Refrigerated water fountains/chillers, hot water systems, disused irrigation systems, and mains-connected water dispensers also need to be completely flushed and restored to a manufacturer recommended temperature. Mains-connected dispensers may have multiple reservoirs, each tap could require separate flushing;
4. Ornamental fountains, bottle water dispensers, outlet fittings, sediment filters, filter casings also require cleaning and disinfection. Other water-using devices, such as ice machines, may require additional cleaning steps in addition to flushing, such as discarding old ice. Follow water-using device manufacturer instructions.
5. Flushing Standard Operating Procedure that includes above steps at minimum shall be developed.

Validation

Importantly, there must be evidence that contaminated or potentially contaminated water has been cleared from the distribution system by flushing and/or disinfection. This evidence shall include, but not limited to a manual calculation based on diameter of pipes, field residual chlorine testing ($\geq$ 0.2 mg/l), and laboratory testing (e.g. Heterotrophic Plate Count). Buildings with vulnerable populations must undergo testing confirmation. Monitoring of flushing protocol shall be conducted by a suitably qualified and experienced Facilities Management staff. External analytical work must conform to international and industry accepted practices and standards.

Records

Standard Operating Procedures for flushing shall be documented by operators of water systems and a field log must be maintained and kept up to date.