What's New?
COVID-19, Building Water Safety, and Fixing Pipes

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Plumbing Testing Facility at Purdue

Onsite Testing and Technical Support

CBBEL Webinar

June 18, 2020
More information here... www.PlumbingSafety.org

A Resource for All
✓ Plumbing news
✓ Plumbing education videos
✓ Plumbing explainers
✓ List of projects
✓ Scientific opinions
✓ Resources ➔ presentations
✓ Scientific reports
✓ External plumbing docs

Access to world-class expertise, capabilities, and education in and outside Purdue

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June 18, 2020
COVID Specific Building Water Safety Support Resources

- Advice for building owners, health officials, utilities
- Building water safety education videos
- Guidance on how to create flushing plan
- Access to the Building Water Safety Study
- Guidance issued on building water safety

Restoring Water to Medical, Residential, and Commercial Buildings, Shutdowns, Unsafe Water

The COVID-19 pandemic has caused widespread building shutdowns, but also emergency restoration of water to previously closed medical facilities and homes. Several serious building drinking water safety risks exist. As people begin using the water again, they will encounter extremely stagnated water with excessive lead, copper, and bacterial concentrations, that may include harmful organisms like legionella that can cause disease outbreaks.

There are no national or industry guidelines for building reopening after extended shutdowns.

The U.S. National Science Foundation funded Purdue University researchers to rapidly address this serious public health concern. This rapid response effort involves partnerships with the American Society of Plumbing Engineers and International Association of Plumbing and Mechanical Officials and collaborations with other building water and public health experts from across North America.

[ NSF government website description of this rapid response grant ]

Questions

I am looking for...

- A list of your rapid response efforts in response to the COVID-19 outbreak
- Advice on what I should do as a public health official, building owner, or water utility
- Download a copy of the Experts' Building Water Safety Study released April 7, 2020
- Guidance on how to create a building flushing plan
- Brief educational videos on building water safety topics
The coronavirus pandemic has prompted low to no water use in >5.6 millions buildings – in the U.S. alone
Corporation Stop

Water Main (metal or plastic)

Water Utility Responsibility

Commercial district

Water meter

PROPERTY OWNER RESPONSIBILITY

Utility Service Line (metal or plastic)

Property Service Line (metal or plastic)

Street

Fire Hydrant

CLEVELAND BUILDING

Single vs. Multiple tenants

Property Owner Responsibility

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Stagnation **noun**

stag·na·tion | \stag-'nā-shən

a state or condition marked by lack of flow, movement

When water does not flow well; areas of stagnant water encourage biofilm growth and reduce temperature and level of disinfectant
U.S. National Science Foundation RAPID Award 2027049

Shutdowns and Consequences - Extreme Plumbing Stagnation and Recommissioning

1. Support to the plumbing and public health sectors on building water safety guidance and decisions, ongoing
2. Building water safety review due to prolonged stagnation with experts from 7 private and public sector organizations, ongoing
3. Field testing to determine how impacted building water safety is in actual large buildings, ongoing
4. Lab testing to determine how to fully recover contaminated building water system devices and equipment, initiating
5. Help transform public awareness, ongoing

Helping

Helping

Purdue University

CBBEL Webinar June 18, 2020
Building water safety review due to prolonged stagnation with experts from 7 private and public sector organizations – FREE DOWNLOAD

Collaborative effort
Caitlin R. Proctor, Ph.D., Purdue University
William Rhoads, Ph.D., Virginia Tech
Tim Keane, Legionella Risk Management, Inc.
Maryam Salehi, Ph.D., University of Memphis
Kerry Hamilton, Ph.D., Arizona State University
Kelsey J. Pieper, Ph.D., Northeastern University
David R. Cwiertny, Ph.D., University of Iowa
Michele Prévost, Ph.D., Polytechnique Montreal
Andrew J. Whelton, Ph.D., Purdue University

Evidence used as the basis of guidance recommendations.

https://doi.org/10.1002/aws2.1186
Water safety in commercial plumbing

Water source
Service line
Safety devices including valves
Water treatment devices
Water service and distribution piping and faucet connectors
Hot water heating, recirculation system
Fixture and fixture fittings
Pumps, tanks
Point-of-use devices

Table 1. Types of building plumbing components

<table>
<thead>
<tr>
<th>Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water source</td>
<td>Municipal water, onsite well, treated surface water, rainwater.</td>
</tr>
<tr>
<td>Service line</td>
<td>Pipe system that carries water from the source to the building water system. Service line materials are variable and may or may not be the same as indoor pipes.</td>
</tr>
<tr>
<td>Safety devices including valves</td>
<td>Pressure relief valve, pressure reduction valve, isolation valve, mixing valve, thermostatic mixing valves, backflow prevention device, water heater anode. Materials can include brass, copper, lead, plastic, and stainless steel.</td>
</tr>
<tr>
<td>Water treatment devices</td>
<td>Filter, strainer, water softener, chemical addition equipment for disinfection and corrosion control.</td>
</tr>
<tr>
<td>Water source and distribution piping and faucet connectors</td>
<td>Various material types have been used to include acrylonitrile butadiene styrene (ABS), brass, cast iron (CI), chlorinated polyvinyl chloride (CPVC), copper, crosslinked polyethylene (PEX), ductile iron (DI), high density polyethylene (HDPE), lead, lead lined steel, multilayer pipes, polyethylene raised temperature (PERT), polypropylene (PP), unplasticized polyvinyl chloride (uPVC), polyvinylidene fluoride (PVDF), black steel, stainless steel.</td>
</tr>
<tr>
<td>Hot water recirculation system</td>
<td>Hot water is pumped through primary and secondary water heater loops, which serve different building zones to reduce delivery time of hot water. These must be hydraulically balanced. Equipment includes master mixing valves, local mixing valves, flow balancing valves, pressure reducing valves, hot water return pumps and water heaters. Multiple temperature loops may exist. Ogdenites of pumps may be intermittent in some systems.</td>
</tr>
<tr>
<td>Fixtures and fixture fittings</td>
<td>Aerator, air wrashers, atomizers, bathtub, bidet, decorative fountains, dishwasher, drinking fountain, eyewash stations, manual faucets, electronic faucets, faucet flow restrictors, hoses, point of use mixing valves, hot tubs, humidifiers, ice machines, misters, shower head, shower wand, HPA, hand spout, toilet, urinal, washbasin</td>
</tr>
<tr>
<td>Pumps</td>
<td>Pumps are often used for pressure boosting within the building (i.e., for multi-story buildings) where water pressure entering the building is not adequate for water use at distant locations. Pumps are also used for hot water recirculation systems.</td>
</tr>
<tr>
<td>Tanks</td>
<td>Standard water heater, pressure tank, on-demand water heater, hydrothermal tanks, cold water supply storage tank. Water heaters can contain Mg or Al sacrificial anodes and plastic dip tubes.</td>
</tr>
<tr>
<td>Point-of-use devices</td>
<td>On-faucet treatment system, under sink treatment system.</td>
</tr>
</tbody>
</table>

https://doi.org/10.31219/osf.io/qvj3b

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Stagnation has impacted various buildings

- Gyms
- Salons
- Offices
- Restaurants
- Retail
- Daycares
- Schools
- Government Buildings
- Colleges & Universities
- Hotels & Motels
- Sports & Entertainment Venues
- Casinos
- and more...

Courtesy of: Gordon & Rosenblatt, LLC
Food preparation areas

Bathrooms

Water fountains

Point-of-entry devices

Point-of-use devices

Breakrooms

Point-of-use devices

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Normal water use refreshes:
- disinfectant residual
- corrosion control

Old water (not refreshed):
- bacterial growth
- corrosion not controlled

Disinfectant in water – used to reduce microbial growth in water, typically chlorine

Corrosion control – used to reduce metals leaching, stabilizes pH and may add chemicals
Prior to the pandemic, stagnation posed health risks. The time scale of concern can sometimes be just a few days.

- **Copper** can leach
  - Nausea, vomiting, diarrhea, abdominal cramps

- **Lead** can leach
  - Nausea, vomiting, diarrhea, abdominal cramps, longer-term developmental issues with children

- **Scale** can be suspended

- **Harmful organisms** (e.g., *Legionella pneumophila* and other opportunistic pathogens) can grow - better
  - Many organisms cause respiratory illness, and other infections can occur

Exposure Routes of Concern: Ingestion, Dermal, Inhalation

Most legionellosis outbreaks detected before COVID-19.
Since March 2020, there have been more than 45+ guidance documents telling building owners what they could do to prevent and deal with stagnation situations.

Many differ quite dramatically. Some lack key info (safety, devices, sensitive population, etc.).
Why are they so different?

• Different perspectives - sides of the elephant
• Different starting information about water safety or plumbing
• Guidance targeted for different readers
• Deliberate step-by-step documents vs. general advice
• Some are derivatives of others, & others... & others!
• Some have been revised (version 3 since March 2020)
• Media, water utilities, & associations making even brief(er) messages
How could we *prevent* water quality problems?

**Keep the water moving! ≠ stagnation**

- Source water must be fresh (utility, onsite well, Source may need to flush!)
- Clean devices and equipment
- Flushing – Keep water fresh, start at entry
- Water heater and recirculation loops – Keep hot water hot, Keep cold water cold
- Document, document, document
What actions can be taken to deal with water quality deterioration?

• Recommissioning plumbing
  ➢ System integrity checks
  ➢ Flushing (and cleaning)
  ➢ Shock disinfection
  ➢ Testing

• Professional help might be needed
  ➢ Address complex mechanical and treatment equipment
  ➢ Develop effective flushing plans
  ➢ Perform shock disinfection safely (thermal or chemical)
  ➢ Perform accurate testing
Transmission of Legionnaires’ Disease through Toilet Flushing

Jeanne Couturier, Christophe Ginevra, Didier Nesa, Marine Adam, Cyril Gouot, Ghislaine Descours, Christine Campèse, Giorgia Battipaglia, Eolia Brissot, Laetitia Beraud, Anne-Gaëlle Ranc, Sophie Jarraud, and Frédéric Barbut

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Suggested citation for this article
Flush and More Intensive System Cleaning Could Make People Sick

Engineering Controls
- Fill sink and floor drains traps with water
- Maintain pressure when flushing
- During flushing (especially initial), many methods to reduce exposure: Cover toilets, showerheads, faucets, reduce splashing, use hoses
- Flooding, cross-connections, dealing with waste

Administrative and Work Practice Controls
- Temporarily forbidding use of high-risk exposure items (showers, hot tubs, decorative fountains)
- Temporarily closing facilities to concentrate use

Personal Protective Equipment (PPE)
- Protect against scalding
- Protect against chemical exposure
- OSHA and other agencies recommend respirators if Legionella is suspected or possible

OSHA
N95 respirators, but recommends voluntary use of N100 “if Legionella contamination is possible”

AIHA
P100 HEPA filter respirators when sampling building water and Legionella may be present

CBBEL Webinar
June 18, 2020
Instructors:
Prof. Andrew Whelton, Dr. Caitlin Proctor, Civil, Environmental, Ecological, Biomedical, Materials Engineering Depts.

Building water systems are sitting at low to no occupancy across the globe due to the COVID-19 pandemic. Stagnant water in them can pose significant human health risks due to chemical and microorganism accumulation and exposure. Professionals will be introduced to engineering and science principles underlying building water systems, issues associated with system maintenance, and strategies for investigating and responding to issues.

The learning objectives are to:
1. Describe the chemical and microbiological contaminants common to building water systems for stagnant and flowing water,
2. Explain the factors that control contaminant accumulation in building water systems,
3. Recognize water testing methods and limitations,
4. Identify remediation practices for reducing contaminated water from the systems, and
5. Recognize how to create and test building water system flushing plans,
6. Develop strategies to avoid and remediate water quality problems, using real-building examples, as-built drawings, and other resources.
7. Recognize where to find additional resources.

If interested, email awhelton@purdue.edu.

Pre-requisites: Be at a health department, regulatory agency, or utility.
Cured-in-Place-Pipe (CIPP) for sanitary sewer, storm sewer, and potable water pipe repairs
Uncured RESIN tube delivered on a truck

Uncured RESIN tube inserted into damaged pipe (raw chemicals)

Uncured RESIN tube inflated with air inside host pipe

“Curing (Hardening) Method”
Hot Water or Steam or UV Light

Hard ends are cut off

Pipe allowed into service

Water flow
What is **Waste**? Merriam-Webster Dictionary

**waste**  noun

4  a : damaged, defective, or superfluous material produced by a manufacturing process: such as

(1) : material rejected during a textile manufacturing process and used usually for wiping away dirt and oil
   // cotton waste

(2) : SCRAP

(3) : an unwanted by-product of a manufacturing process, chemical laboratory, or nuclear reactor
   // toxic waste
   // hazardous waste
   // nuclear waste

www.dictionary.com
Approx. 5-15 psi air or steam pressure used against the uncured resin tube

At the street....
Approx. 5-15 psi air or steam pressure used against the uncured resin tube

Direct closed pipeline to buildings!

While Contractors work at the street....
Private Property (NOT for contractors)

HVAC Intake

Sump Pump

Utility/City Property (Worksite only for contractors)

Approx. 5-15 psi pressure used against the uncured resin tube

Chemical Plume

Windows

Doors

Sump Drain

Foundation Crack

HVAC Vent

Cracked Sewer Lateral

Chemical Plume

Approx. 5-15 psi pressure used against the uncured resin tube

Their chemical waste leaves their worksite – traveling above and below ground
Private Property (NOT for contractors)

- HVAC Intake
- HVAC Vent
- Windows
- Doors
- Foundation Crack
- Sump Pump
- Sump Drain

Utility/City Property (Worksite only for contractors)

- Contractors blow chemical waste into buildings and the environment

Approx. 5-15 psi pressure used against the uncured resin tube

wind

Cracked Sewer Lateral

28
This is **NOT steam**. This **WASTE** contains particulates, droplets, partially cured resin, VOCs, SVOCs, and more...

Many workers have not been wearing respiratory or dermal protection.

*Waste has been allowed to enter buildings and public spaces.*
Since our 2017 study revealed serious worker and public safety risks due to the CIPP process...

✓ 140+ chemical exposure incidents found involving children and adults in schools, homes, and office buildings
✓ 1 NIOSH UV CIPP study (health risk exists) [NIOSH thermal CIPP in progress]
✓ 1 worker fatality, OSHA investigation (IL)
✓ 1 criminal investigation (PA)
✓ 5 peer-reviewed testing & toxicology studies
✓ 1 industry study
  • Not just styrene found, benzene plus more, only looked at vapors not mixture
  • Styrene found well above 3.1 ppm, the max. level previously claimed by industry (and cities) for 20+ years
  • Some data are not interpretable. Other data buried in the appendix.
✓ California issued statewide CIPP safety alert in May 2020 with requirements
✓ Cities and contractors *still* permit waste discharge into nearby buildings
Today, CIPP Presents Serious Safety Risks

- CIPP process waste is blown into the air, leaves worksite
- Cities do not explicitly prohibit this in contracts
- People (i.e., children, pregnant women, others) have been and can be exposed inside and outside buildings
- Waste can enter buildings by many pathways
- SDSs lack key chemical information, unreliable
- 4-gas meters are ineffective, PIDs can give false readings
- Often
  - Exposure victims are directed to call the Construction Contractor, not health department (PROBLEM!)
  - Contractors, Public Works, Engineering Firms, City Officials issue blanket safety claims for any exposure
  - Health officials are not informed, during or after incidents – victims are on their own
- Critical air testing rarely conducted
- Tip of the iceberg. Exposures happening, some very serious.
Pouring water in drains does not prevent indoor exposure during CIPP manufacture.

Less than 1 psi pressure can cause water blowback in an average plumbing trap (p-trap).

CIPP contractors use 5-15 psi pressure at street.

Contractors also may say:
1) Put a towel in the drains
2) Wrap toilet with towel
3) Wrap toilet with saran wrap

This implies their chemical waste will leave their worksite and enter private property.
California Department of Public Health, Revised May 2020

Overview

• Health effects
• Concerns during CIPP installation
• Recommendations for permitting agencies

Chemical Exposure Symptoms Reported for Persons Associated with Exposure to the Air and Liquid CIPP Wastes

Headache, Nausea, Vomiting, Loss of consciousness, Eye irritation, Nostrils burning, Dizziness, Shortness of breath, Tightness of chest, Lethargy, Faint, Gagging, Confusion
What You Will Learn About

1. The Basics of Plastics
2. The CIPP Manufacturing Process
3. Waste is Created During CIPP Manufacture and It's Forms and Composition are Varied
4. How Chemicals Enter Nearby Buildings and Public Spaces
5. Human Health and Environmental Impacts

Highlights

• 4-gas meters are not effective for monitoring CIPP waste discharge.

• Photoionization detectors (PID s) [sometimes called organic vapor monitors] may indicate something is changing, but at CIPP worksites they can be off by a factor of 10x to 1000x.
PREVENTION – CIPP associated HAZMAT incidents

1. Explicitly require air and liquid waste capture in construction contract. Do not permit chemical discharge into the air.

2. Explicitly require air monitoring to PROVE no release of chemicals above and below ground.

3. Require physical setback distances that prevent the public from being near waste discharge points.

4. Do Not Approach worksite unless proper PPE donned. (i.e., respirators, etc.)

5. Require contractors direct any and all complaints to medical professionals. They are NOT doctors.

6. If related odors are in buildings, demand an immediate halt to installation because of public safety.

7. Health department should be monitoring each installation and be prepared to respond.

8. Sometimes contractors and public works say untrue statements about exposures to parents and others during response, and never alert health department (city, county, state).

Recommendations here
https://docs.lib.purdue.edu/jtrpaffdocs/30/