Environmental Health Committee (EHC) Emerging Issue Brief:

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Toxic Hazards of Community Drinking Water Entering a Building During Distribution System Free Chlorine Burns

What is the issue?

Nitrification and biofilm growth within engineered water systems (EWSs) drinking water distribution systems (DWDSs) are major issues for drinking water treatment plants utilizing chloramine disinfection. Engineered water systems (EWSs) include DWDSs and building premise plumbing [1]. Many chloraminated plants periodically use “chlorine burns” - switching to chlorine disinfection for several weeks to mitigate these issues. Water quality deterioration due to nitrification is common in chloraminated community drinking water systems [2]. In the United States, nitrification occurs in one-third to two-thirds of chloraminated EWSs [3]. Free ammonia appears in chloraminated EWSs due to excessive free ammonia dosing, chloramine decay, and the reactions between chloramines and reducing agents [4]. Eliminating free ammonia from chloraminated EWSs is the key to nitrification control [5]. A chlorine burn (i.e., free chlorine conversion, breakpoint chlorination, or free chlorine maintenance) is the most popular nitrification control assay [6]. Drinking water utilities conduct chlorine burns once or twice per year during the warm season for one to several weeks [7]. During a chlorine burn, water utilities substitute free chlorine for monochloramine as the secondary disinfectant to kill nitrifiers and other microbes, disturb biofilms, and oxidize free ammonia and chloramines to nitrogen gas in water pipes.

Free chlorine burns cause increased corrosion in building premise plumbing, resulting in increased lead and copper leaching, increased toxic disinfection byproducts, sloughing of opportunistic pathogens residing in layers of biofilm, and increased indoor air contamination from resulting aerosolization in plumbing fixtures and water use appliances. Recently, during a city-mandated month-long free chlorine conversion, residents experienced severe water discoloration and a pungent chemical odor. The family of a teen in Trinidad, Texas say she suffered a chemical burn after taking several showers using the city's water, which officials have long admitted having problems with [8].

What does it mean to ASHRAE?

ASHRAE has developed standards to ensure safe and healthy indoor environments, including ASHRAE Standards 188 [9] and 514 [10]. These two standards focus on different aspects of building design, maintenance, and operation related to health and safety. The ASHRAE standards have information on Legionella risk assessments, testing, and water management programs (WMP). WMPs, as currently

recommended, do not consider significant changes in source water quality, specifically during periods of free chlorine burns.

What action should be considered?

ASHRAE should address free chlorine burns—often called chlorine conversions or burnouts by municipal utilities—by updating its water management guidelines to include specific risk-communication, chemical monitoring, and temporary filtration protocols during transient utility spikes. ASHRAE guidelines (such as ANSI/ASHRAE Standard 514 and Guideline 12) dictate robust Water Management Programs (WMPs) to control pathogens like Legionella. To mitigate the impacts of city-wide free chlorine conversions, ASHRAE should expand these resources by focusing on the following actionable steps:

1. Implement Formal Notification Protocols: Require Water Management Teams to establish direct communication with local water authorities so facilities are alerted 2 to 4 weeks prior to a municipal chlorine conversion.
2. Mandate Temporary Control Measures: Outline procedures for building managers to adjust water heater temperatures, install supplemental Granular Activated Carbon (GAC) filters, or utilize Point-Of-Entry (POE) filtration to neutralize excess free chlorine and associated disinfection byproducts (DBPs).
3. Update Testing Guidelines: Recommend increased testing of both free and total chlorine residuals at end-use fixtures during the burnout period.
4. Expand Clinical Warnings: Strengthen warning procedures for vulnerable populations, specifically dialysis patients and aquatic facility operators, to avoid adverse health effects from unintended chemical spikes.

ASHRAE should actively seek solutions by supporting building owners with better tools for use when implementing WMPs. Further, ASHRAE should work with agencies with jurisdiction to compel DWDSs to provide notification to building owners of pending free chlorine burns and support them with remediation techniques as necessary. ASHRAE, in recognizing the consequences of DWDSs free chlorine burns, should be proactive in developing engineering guidelines within the WMPs for minimizing the exposure of these opportunistic pathogens and physical toxic exposures in building systems.

References

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