Water Research Foundation℠

advancing the science of water

DISTRIBUTION SYSTEM MANAGEMENT

LEAD AND COPPER

FACT SHEET

Impacts from Lead and Copper Corrosion

QUICK FACTS

- Lead and copper can cause a variety of physical and mental health effects, and EPA has published the Lead and Copper Rule to minimize their levels in drinking water
- The rule requires all community water systems and non-transient non-community water systems to comply with action levels and sampling/monitoring requirements
- While lead and copper release can be controlled, corrosion science is complex and utilities must remain vigilant

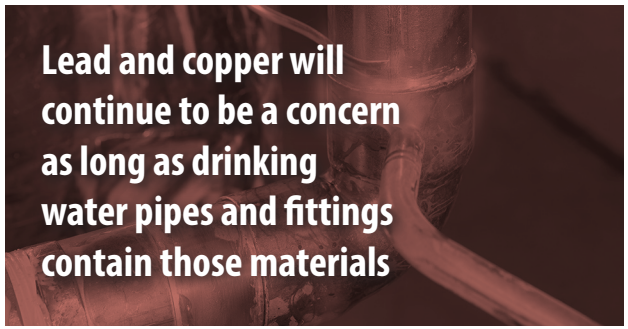
OVERVIEW

Lead and copper in service lines and household plumbing are the primary drinking water corrosion contaminants of concern. The U.S. Environmental Protection Agency's (EPA's) Lead and Copper Rule regulates the concentrations of lead and copper allowed in water and provides a framework for reduction.

Corrosion science is complex. Various control strategies exist for each of these metals, and utilities with elevated lead and copper levels should be aware of research that can help. Utilities in compliance with the rule need to remain vigilant to changes that could impact lead and copper release.

LEAD BACKGROUND

Lead is a naturally occuring element found in the earth's crust, air, soil and water—and household paint before 1978. Even at low levels it can be toxic to humans. Lead can cause a variety of physical and mental health problems affecting healthy adults, and children under six and pregnant women are particularly susceptible.



Most lead enters drinking water through corrosion of household plumbing, including lead service lines and piping and lead-based solder, as well as brass and bronze components. Lead corrosion is complex. (EPA 2013b)

COPPER BACKGROUND

Like lead, copper is a naturally occuring element found in the earth's crust, air, and water. It is also found in food. People who drink water containing copper in excess of 1.3 milligrams per liter may experience short-term nausea. Long-term exposure can affect the liver and kidneys, and people with Wilson's disease can be more sensitive.

Copper is rarely found in source water and mainly enters drinking water through corrosion of household plumbing. Copper corrosion is also complex. Copper release can differ, whether it is released through non-uniform corrosion (pinhole leaks, erosion, galvanic, and microbiologically induced) or whether it is uniform corrosion. In new piping, before a scale can form, copper levels are more likely to be elevated. (EPA 2013a)

EPA LEAD AND COPPER RULE

in 1991, to protect public health by minimizing lead and copper levels in drinking water, the EPA published the Lead and Copper Rule. All community water systems (CWS) and non-transient non-community water systems (NTNCWS) are subject to the rule requirements. Under the rule, both lead and copper have action levels—levels at which a water utility must take action.

All CWSs and NTNCWSs are required to monitor taps for lead and copper. The standard requires first-draw samples at taps in homes and buildings that are at high risk of lead and copper contamination. If an action level is exceeded in more than 10 percent of samples collected at customers' taps, further treatment is required. Systems must conduct monitoring every six months unless they qualify for reduced monitoring. An EPA Quick Reference Guide helps clarify some of the rule's complexities. Proposed revisions to the Lead and Copper Rule are expected to be released in 2015. (EPA 2008)

REDUCTION OF LEAD IN DRINKING WATER ACT

On January 4, 2011, Congress enacted the Reduction of Lead in Drinking Water Act to reduce the allowable lead content of wetted surfaces in drinking water pipes, pipe fittings, and plumbing

TABLE 1. LEAD AND COPPER REGULATORY FRAMEWORK ACTION LEVELS

	LEAD	COPPER
Action Level (mg/L)	0.015 (based on treatment feasibility)	1.3 (based on health for prevention of nausea)
Maximum Contaminant Level	N/A	N/A
Maximum Contaminant Level Goal (mg/L)	0	1.3 (based on aesthetics or taste and staining)
Secondary Maximum Contaminant Level (mg/L)	N/A	1.0

fixtures. The act changed the definition of "lead free" from 8 percent to a weighted average of no more than 0.25% in the wetted surface material. It also established requirements for calculating lead content and created exemptions on certain plumbing products.

LEAD SERVICE LINES AND GALVANIC CORROSION

Many lead service lines were installed across the United States from the early 1900s until they were banned in 1986. Water systems that are unable to reduce their lead levels after implementing various treatment techniques are required to replace at least 7 percent of lead service lines in their distribution systems annually.

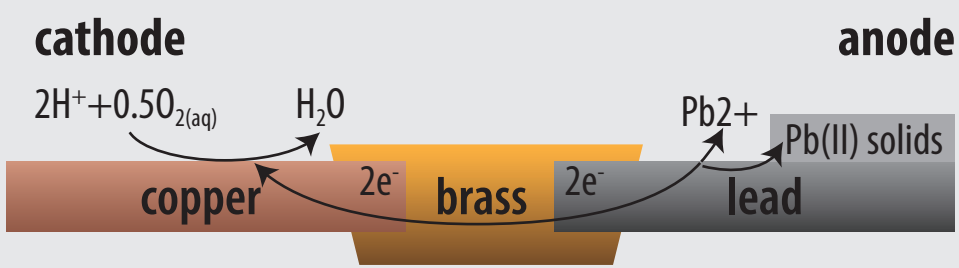
The utility is not required to replace sections of service lines that are privately owned, which results in a Partial Lead Service Line Replacement that causes galvanic corrosion to occur. Typically lead pipe is replaced with copper pipe and the dissimilar metallic pipe materials are connected to restore drinking water service. This condition creates an electrochemical or galvanic cell, which can accelerate corrosion of the lead pipe via galvanic connection to copper. (Welter et al. 2013)

LEAD AND COPPER CORROSION CONTROL

Lead and copper corrosion is very complex. It can vary significantly from one utility to the next, and even within the same distribution system. Some of the water quality factors that can significantly affect lead and copper corrosion are pH, alkalinity, orthophosphate concentration, and disinfectant residual. (Brown et al. 2013)

A Water Research Foundation special report was developed to help utilities navigate the complexities of lead and copper corrosion and its control. The report, *Lead and Copper Rule and Distribution System Corrosion*, provides information on corrosion control effects, treatment process effects, specific water chemistry effects, and material effects on lead and copper release.

FIGURE 1. GALVANIC CORROSION OCCURRING UPON THE ELECTRICAL CONNECTION OF LEAD AND COPPER PIPES IN WATER WITH A BRASS CORPORATION VALVE OR BRASS COMPRESSION FITTING



(source: Welter et al. 2013)

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