E C O L O G Y

W A T E R IS CRUCIAL for human life; in 2010, the United Nations added Article 31 to the Universal Declaration of Human Rights—the right to water. Recognizing clean water standards are integral in maintaining and improving health and living standards. Water supplies need to be safe and reliable.

There are countless waterborne disease cases every year that contribute to mounting hospitalization costs in the U.S. Pollutants can appear in the water supply from man-made occurrences, such as pipe breaks, or by natural events, like algae blooms. In 2014, the water supply for more than 400,000 people in Toledo, Ohio, was declared unsafe because of the presence of microcystins, a toxin released by algae blooms in Lake Erie.

System infrastructure weakens over time, creating vulnerabilities and requiring continued monitoring, maintenance, and, eventually, replacement. The American Society of Civil Engineers (ASCE) evaluated the nation’s drinking water infrastructure in 2013 and gave it a grade of “D.” Failures in drinking water infrastructure can be detrimental in more ways than one, the ASCE report explains: “Broken water mains can damage roadways and structures and hinder fire-control efforts. Unscheduled repair work to address emergency pipe failures can also disrupt transportation and commerce.”

The ASCE estimates there are 240,000 water main breaks per year in the U.S. Systems left to degrade create a vulnerability to contamination leading to human health risks.

While people work on updating the country’s infrastructure, communities in need of safe drinking water should have an alternative besides bottled water. Scientists have demonstrated that filters can remove lead and other contaminants of concern with proper maintenance and can be an immediate solution to provide safe water to residents while the water system is being repaired.

The Safe Drinking Water Act (SDWA) is a Federal law to protect public drinking water supplies. Provisions under the Act require the Environmental Protection Agency to establish standards for drinking water quality and technical and financial programs to ensure drinking water safety. The Act has seen multiple amendments over the years, as scientists keep expanding what we know about contaminants in water.

There are two limits set by the EPA for contaminants the agency chooses to regulate under SDWA, the Maximum Contaminant Level (MCL) and the Maximum Contaminant Level Goal (MCLG).

The EPA uses three criteria when deciding to regulate a contaminant: the contaminant may have an adverse effect on the health of persons; the contaminant is known to occur or there is a high chance that the contaminant will occur in public water systems often enough and at levels of public health concern; and, in the sole judgment of the Administrator, regulation of the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems.

MCLG is not enforceable; rather, it is a public health goal. This level only examines public health and does not take any other factors into consideration. The enforceable MCL is the allowable limit of the contaminant in drinking water. MCL is set as close to the MCLG as possible from a cost point of view. If a dependable method to measure the contaminant at the limit the EPA wants to set is hindered by economical and technical limitations, then the EPA will develop a treatment technique in place of MCL. These regulations help create water quality parameters and are being evaluated constantly. Contaminants that do become regulated are tracked for occurrence to further our understanding and to perfect treatment.

There is no safe amount of lead exposure. Some potential health effects caused by lead include damage to the brain, kidneys, bone marrow, nervous system, and red blood cells. It also can cause reduced intelligence, impaired hearing, and decreased growth in children.

The EPA published the Lead and Copper Rule under the Safe Drinking Water Act in 1991. With this rule, the EPA set the MCL for lead at 15 parts per billion (ppb). The agency also established a MCLG at zero. When 10% of samples exceed 15 ppb, the utilities are required to take steps to reduce those levels.

Possible sources of lead include—but are not limited to—paint, toys, and water. According to the Centers for Disease Control and Prevention: “Although there are several exposure sources, lead-based paint is the most widespread and dangerous high-dose source of lead exposure for young children.”

However, also can leach into a water distribution system through service lines, lead containing solder, brass fittings of different types, and interior plumbing. Other pathways that are not a direct source into water include industrial processes, mines, and smelting.

Leak pipes commonly were used commercially and residually in the 1900s because lead is long-lasting, durable, and easy to work with. Nearly all homes built prior to the 1980s still have lead solder connecting copper pipes.

In 1991, with the creation of the Lead and Copper Rule, the EPA estimated there were 10,200,000 lead service lines in the U.S. A 2016 analysis by the American Water Works Association (AWWA) estimates that 6,100,000 lead service lines remain in use in the U.S. The estimate for replacing them is $30,000,000,000. Commonly, homeowners own part of the lead service line leading up to their house. This means a part of the replacement cost will be on them. This disproportionately affects low-income households, which oftentimes cannot pay the replacement costs.

Under the traditional paradigm, when contaminants enter drinking water after leaving the centralized treatment facility, the solution is focused on infrastructure repairs. In the recent well-publicized case of Flint, Mich., after a buildup of events caused lead to leach into the water, infrastructure needs were apparent.

During a visit to Flint in May, Pres. Barack Obama explained, “Even
with all the money, even with an efficient, speeded-up process, it’s going to take a while for all the pipes to be replaced. It’s not going to happen next month. It’s not going to happen six months from now, [but] we’ve got to get started, and you need to see that... progress is being made....

The financial impacts of infrastructure repairs, meeting regulatory requirements, and addressing emergencies definitely can strain a region’s resources. In some cases, the costs are burdensome, especially for small communities.

Whether replacing pipes or adding even more centralized treatment, these repairs take time and money, which is why they normally are part of a long-term plan. Looking at overall infrastructure repairs for community water systems, AWWA in 2012 concluded that, by 2050, the aggregate investment needs will be more than 1.7 trillion dollars. EPA's 2013 National Assessment on public water infrastructure needs reported a total of 20-year capital improvement need of at least $384,200,000,000. This represents the projects necessary from Jan. 1, 2011, through Dec. 31, 2030, for water systems to continue supplying safe drinking water.

Replacing just a lead service line can be complicated. The part of the line leading to the home normally is the homeowner’s responsibility, not the utility. The AWWA Guide for Water Systems Addressing Service Line Repair and Replacement estimates the replacement costs on the utility side range from $800-$3,200; the customer side, $450-$10,000— with the average price being $2,144. In some cases, a utility might choose to replace only its part of the lead service line. This is called a partial lead service line replacement and studies have shown there are adverse consequences attributed to this practice.

In addition to research done on partial lead line replacement, lead levels are affected by physical disturbances. Examples are meter installation or replacement, service line leak repair, or significant street excavation. In Pres. Obama’s Flint speech, he said, “While you are waiting to get your pipes replaced, you need to have a filter installed, and use that filter.” The President is correct; it will take time to follow through in the long-term solution of replacing lead service lines. Also, if a line is replaced only partially, continued monitoring might find the continuation of treatment is needed at the home.

There are various forms of lead found in water supplies (particulate or dissolved). Commonly, 40% to 60% of lead found in municipal supplies is present in the particulate or insoluble form. Therefore, more than one technology is available for lead abatement.

The Water Quality Association, a not-for-profit representing the water treatment industry has produced an information sheet on treatment for lead in drinking water:

- Removal of lead by reverse osmosis is effective because the membrane removes not only the soluble lead impurities but, typically, 90% to 95%, but acts as a barrier to the particulate lead.
- Data verifies that solid block and precoat adsorption filters, using a mixture of activated carbon and a lead adsorbent, can remove insoluble lead.
- Sodium cycle, strong-acid ion exchange water softening is a well-established technology for removing ionic forms of lead, but the process has its limitations. Typically, ion exchange softeners must be operated at no more than 2.0 to 3.0 gallons per minute flow rate per cubic foot of ion exchange resin for best results. It is important to note ion exchange will not remove particulate forms of lead.
- Distillation. Although data is sparse, properly designed and operated distillation units are capable of reducing both particulate and insoluble forms.

The treatment methods currently on the market may differ widely in their effectiveness in treating specific contaminants, and performance may vary from application to application. Therefore, selection of a particular device or system for health contaminant reduction should be made only after careful investigation of its performance capabilities based on results from competent equipment validation testing for the specific contaminant to be reduced. Water should be monitored periodically and the application of the water treatment equipment must be controlled diligently to verify continued performance.

Here are a few tips when looking for water treatment products: get your water tested by a certified laboratory; consult a water treatment professional, who will be able to help residents understand their water analysis and recommend appropriate remediation; third-party certified products tested to national standards provides verification for the claims made on the product.

Proposed changes to the Lead and Copper Rule are expected in 2017. However, lead is not the only contaminant that can find its way into water supplies or the only contaminant requiring monitoring and possible additional treatment. The EPA currently regulates around 90 contaminants, with more being evaluated for future regulation.

Additionally, while the majority of the conversation on water quality is focused on public water, private wells also are facing contamination challenges. Private wells are not held to the same regulations as municipal water systems and are the responsibility of the resident. Private well owners are encouraged to test their systems regularly and seek appropriate remedies, such as water filters or reverse osmosis, as necessary, or contact a water treatment professional.

Replacing water infrastructure is the ultimate goal for alleviating many of the water-quality issues plaguing the nation. Meanwhile, water-treatment issues will continue, and alternative solutions will be required to bridge the gap between immediate clean-water needs and long-term solutions. ★

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