Lead in Water – Significance, Sources, and Test Methods[1]

Terry L. Engelhardt, Application Development Manager – Drinking Water

Significance and Sources of Lead

Lead is a naturally occurring element in nature; element 82 in the periodic table with the symbol "Pb". Lead is the end radioactive decay product of uranium 238. There are at least six isotopes of lead the most common and stable of which is Pb 207. All known isotopes have very long half-lives. The element is not considered to be radioactive.

The symbol Pb is from the Latin word plumbum. The English words plumb and plumbing are derived from the Latin. In ancient civilizations lead was commonly used for dishes, pans, cups and other cooking and eating purposes as well as for water pipes. Use of lead has continued over the centuries in a variety of uses have included paint, plumbing fixtures (brass alloys), solder used for copper pipe joints and pipes, and gasoline. However lead, as with other heavy metals, is harmful to living organisms, including humans.

Scientific evidence shows elevated levels of lead in blood can cause serious mental and physical health problems, especially for children. The United States Environmental Protection Agency (USEPA) issued regulations covering lead and copper in drinking water and included an extensive list of health effects.

Lead produces negative effects in the body as low as 10 µg/dL of blood or less. It accumulates in the body from a variety of sources: water, paint, dust, air, soil and food. Lead interferes with a number of biochemical processes on the cellular level. In children, this results in altered physical and mental development, interference with growth, and deficits in intellect, attention span and hearing. Elevated levels of lead in women result in low birth weights and premature births. Blood pressure increases in both men and women when lead levels in the blood are elevated, and evidence indicates lead probably is a human carcinogen.

Because there is an accumulative effect with blood lead levels, the USEPA has determined there is no "safe" threshold below which lead has no negative effects. Furthermore, lead serves no purpose in the body and is not required for life. The USEPA maximum contaminant limit in drinking water is 15 µg/L with a goal of 0 µg/L.

Lead has been removed from many products in the environment including plumbing components, but many older fixtures still remain in service. Lead is rarely a problem in source water whether from surface water or ground water. Today, lead in water is almost exclusively from old plumbing still in homes as well as commercial and industrial buildings. As the water stands unused in building plumbing, metals (lead, copper) leach from the pipes, fixtures and solder into the water. At best the water after standing will have an off-taste.

In older buildings it is a good practice to run the water for at least five minutes before collecting water for cooking or drinking so one does not consume water that may contain elevated levels of contaminants. In buildings that have been unused for days (homes after a long vacation, commercial buildings and schools over long periods of vacancy), it would be prudent to flush for longer periods.

While the problem of elevated levels of lead in water are most commonly at the point of use, water utilities are required to provide water that discourages leaching of metals (corrosion) into the water. And the utilities also are required to conduct testing for lead throughout the system, including in private residences as well as commercial and industrial buildings.

[1] *A significant portion of this document is excerpted from Simplified Testing for Lead and Copper in Drinking Water, by Charles R Gibbs, Hach Lit No. 7038, 1994.*

Test Methods for Lead

Current USEPA regulations for lead and copper are long, complex, and comprehensive. Maximum contaminant level goals (MCLG) and action levels, as well as treatment techniques and monitoring requirements, are mandated.
The usual requirements for public notice, record keeping and reporting, variances, exemptions, and compliance schedules (based on system size) are in effect. In addition, analytical methods and laboratory certification requirements stipulate applicable data must be reported to the USEPA.

Any method may be used for testing conducted for process control, system surveys or customer education purposes. Goals of the regulations are to provide customers with water containing 0 µg/L lead and less than 1.3 mg/L copper right from the time they turn on the tap in the morning. However, the action level for lead contamination is 15 µg/L of lead (0.015 mg/L) in "first-draw" samples from high risk locations. The action level for copper is the same as the goal. Treatment techniques are required to minimize corrosion if the highest 10 percent of the samples tested exceed the action levels. Source water treatment also may be required. In addition, educational materials must be distributed to help people avoid exposure to lead.

Testing to demonstrate compliance and for reporting must be completed with an approved method, typically atomic absorption. The sample must be collected, preserved and sent or transported to an approved laboratory. However Hach® Leadtrak® Fast Column Extraction[2] is a much simpler, less expensive method that permits on-site testing to ascertain whether the site merits further testing and investigation. It is now possible to obtain immediate results on site that are comparable in accuracy and precision to those obtained days later in the laboratory. This aspect of immediacy offers great advantages:

- Sources of lead can be immediately tracked and identified
- Results are available for follow-up testing while personnel are on the site
- Screening prioritizes samples for laboratory confirmation
- Results can be used for demonstration and education.

Compared to atomic absorption instrumentation, the Leadtrak system offers a cost-effective way to perform the broad surveys needed when operating a small to medium-sized drinking water system. Checks of only a few sites in the distribution system are not sufficient. Sources for high levels of leached lead—the sites, coolers and fixtures—must be located. Even within the same building there can be a wide variation in lead at the various taps.

Using the Leadtrak method reduces both cost and response time. Often, only samples that exceed a screening action level are sent to the laboratory for Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS) confirmation. Additionally, if high levels are found, on-site results can guide the selection of other sampling points to aid in the location of lead sources. Changes to water conditions (such as flushing lines, changing hardness or pH, etc.) can be immediately checked for effectiveness. A U.S. Postal Service study found that: "The field kit screening techniques can be utilized as a very effective means of reducing costs associated with a water testing program." Other studies reached the same conclusion. And, all of the studies found that Leadtrak results were comparable in accuracy to the GFAAS reference method at the 95-99% confidence level.

The Leadtrak method may be completed with any of Hach's spectrophotometers using the Reagent Set (p/n 2375000) for lead determination by the Leadtrak® Fast Column Extraction. Hach Method 8317. Range: 5 to 150 µg/L as Pb. Sample Size: 100 mL. 20 tests/reagent set. The method is not suitable for use with the DR800-series or DR900 Colorimeters. For portable use a Pocket Colorimeter™ II Leadtrak kit is available, p/n 5870021 which includes a carrying case, instrument, reagents and instructions.

For more detailed information, see "*Simplified Testing for Lead and Copper in Drinking Water,*" Technical Information Series—Booklet No. 19, By Charles R. Gibbs, Hach, 1994. It can be downloaded without charge from Hach's website: www.hach.com.

[2] *Leadtrak is a registered trademark of Hach.*

DOC042.53.20239.May16

HACH WORLD Headquarters: Loveland, Colorado USA

United States:	800-227-4224 tel	970-669-2932 fax	orders@hach.com
Outside United States:	970-669-3050 tel	970-461-3939 fax	int@hach.com

hach.com