VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

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LEAD IN DRINKING WATER

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Lead and Copper Rule (LCR; 40 CFR Part 141, Subpart I) requires waterworks owners to conduct sampling at consumers' taps following the completion of a national water distribution system materials survey. Under the LCR rule, EPA established a lead action level of 15 parts per billion (ppb). To show the relevance of 15 ppb, one ppb is equal to one penny in $10 million, or one second in 32 years, or one inch in 16,000 miles. The action level was established to minimize long-term exposure through ingestion of water. It is not strictly based on adverse health effects. It is based on one liter, first-draw samples collected at places where the highest level of lead might be expected. The action level is exceeded if the level of lead in more than 10 percent of the targeted tap water samples is greater than 15 ppb (90_{th}percentile). Exceeding the 15 ppb action level will not necessarily cause poisoning after a short-term exposure. The action level is different than a Maximum Contaminant Level (MCL). The MCLs indicate the maximum permissible level of a contaminant in water, which is delivered to any user of a public water system. These enforceable standards are based upon health effects, feasibility of treatment, and relative ease of implementation. Under the Safe Drinking Water Act (SDWA), if a water system exceeds a given MCL, it is in violation of National Primary Drinking Water Regulations (NPDWRs; unless it has obtained systems which exceed the 15 ppb lead action level, however, are not in violation of the treatment technique. Rather, exceeding the 15 ppb lead action level is merely a trigger for medium-sized and small-sized waterworks to implement optimal corrosion control and waterworks of all sizes to implement source water monitoring and possible treatment, public education, and possible lead service replacement. This action will substantially reduce public exposure to lead in drinking water. The LCR rule specifies that all samples for analysis must be "first draw" water (water that has been left standing in the tap undisturbed for a minimum period of six hours). The LCR monitoring program was intentionally designed to find the highest lead levels in each waterworks. It should also be realized that the levels found do not necessarily represent the lead level in the source water, but also lead acquired from the household plumbing.

SOURCES OF LEAD

Lead is found widely throughout the environment. It is a naturally occurring, bluish-grey metal found in small quantities in the earth's crust. Lead used by industry comes from mined ores or from recycled scrap metal. Lead is primarily used in the manufacture of storage batteries. Sources of lead exposure include lead in paint, gasoline, imported pottery, drinking water, and solder (used to solder joints in water-distribution systems and used in imported food packaging). Lead exposure to the general population results from breathing air, drinking water, and eating many foods that contain lead. The primary route of lead exposure is through foods. Typical concentrations of lead in various foods in ppb are: dairy products, 3-83; meat, fish, and poultry, 2-159; grain and cereal products, 2-136; vegetables, 5-649; fruit and fruit juices, 5-222; oils, fats, and shortenings, 6-73; sugar and adjuncts, 6-73; and beverages, 0.002-0.041. The intake of lead by ingestion of drinking water is typically less than through the dietary intake. EPA estimates that approximately 15 to 20% of a person's total exposure to lead comes from drinking water. Only if an individual consistently drinks from the tap first without flushing the line could there be any public health impact.

Lead in drinking water comes from two sources: (1) raw water supplies and (2) the dissolution of lead-bearing materials present in the household plumbing and public water supply distribution systems. Lead levels in raw water sources are normally negligible. Several studies have shown that the primary source of lead in drinking water is not from the main public water source, such as a lake, or reservoir. The main source of lead is form corrosion by by-products in household plumbing (new and old lead solders and fluxes used to connect copper pipes, brass and bronze faucets, and other metal alloy fixtures) and water supply distribution systems (water service mains, service lines connecting structures to the main, and goosenecks and pigtails connecting the ends of the service line to homes and buildings). Lead levels in drinking water depend on a number of factors, including the amount and type of leaded materials present, the age of those materials, and the corrosivity of water toward lead. All water is corrosive toward metal plumbing materials to some degree. The corrosivity of water toward lead is dependent on the pH and alkalinity of the water, water temperature, and the presence of orthophosphate residuals,

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total dissolved solids, and dissolved oxygen in water. Lead concentrations can vary considerably from system to system, house to house, and even within the same house at different times of the day. Factors that affect lead levels in water, independent of corrosivity, include: (1) the number of age of lead solder joints and quality of work done on the joints; (2) the contact time between the water and the leaded materials; and (3) the length and diameter of the lead service line.

HEALTH EFFECTS

Human exposure to lead has long been an important public health issue. Lead exposures are represented by a broad range of blood lead (PbB) levels and have been associated with a spectrum of health effects. All persons are susceptible to the toxic effects of lead, but young children, infants (who drink baby formulas and concentrated juices that are mixed with water), and fetuses are particularly more susceptible than adults. Children are more susceptible because their bodies are still developing and they absorb and retain more lead than adults. Recent scientific studies showed that lead was harmful at blood concentrations which were once thought to be safe. Low-level exposure to lead in children, six years and below, can cause learning disabilities, hyperactive behavior, slow physical growth, loss of hearing, reduced attention spans, and poor classroom performance. Women of childbearing age are also at risk. Lead can cause impaired development of the fetus, premature birth, reduced birth weights, as well as fertility problems and miscarriages. Adults occupationally exposed to lead and others having potentially large exposures face the risk of lead-induced blood pressure increases.

Lead in water is absorbed variably. In adults, 10-15% is absorbed after consumption of food, and in children approximately 50% is absorbed after consumption of food. Under fasting or semifasting conditions, the rate of absorption rises considerably for adults and possibly for children. The concentration of lead in whole blood has been the most widely used index to identify lead exposure in both acute and chronic poisonings. The U.S. Centers for Disease Control and Prevention (CDC) has established its lead-exposure guideline as 10 micrograms of lead per deciliter (ug/dl) of whole blood and its guideline for medical intervention as 20 ug/dl. The CDC recommends that all children should be screened for lead poisoning at least once a year. This is especially important to children between the ages of 6 months and 6 years. The health effects of lead, at or below 10-15 ug/dl, are less substantiated. The EPA believes that blood lead levels of 10-15 ug/dl constitute a range of concern for health effects that warrant avoidance. These levels do not appear to suggest possible associated health risk. It is difficult to identify a water lead level that best predicts blood lead levels. It is also difficult to clearly identify what lead level in blood is an approximate criterion or threshold below which there are no risks of adverse health effects in humans.

STEPS FOR REDUCING LEAD EXPOSURE

If one is concerned about lead in drinking water, the first action to take is to get the water tested to determine if it contains excessive levels of lead. Testing the water is essential because one cannot see, taste, or smell lead in drinking water. Household drinking water will contain more lead if it sits for a long time in the pipes, is hot, or is naturally acidic. Water samples can be collected directly from the faucet. If a water test indicates that drinking water drawn from a tap in the home contains high levels of lead, the following precautions should be taken: (1) Flush the cold water faucet by running the water for 30 to 60 seconds before drinking it or using it for cooking. This flushing will remove stagnant water which may contain high levels of lead due to leaching from the lead soldered joints, service lines, or fixtures. The flushed water can be used for other household uses, such as washing dishes or watering plants. One may also want to keep a bottle or jug of flushed water in the refrigerator for drinking which will help reduce the amount of flushing. (2) Do not drink, cook, or make baby formula with water from the hot water tap if the water has been sitting in the lines for 6 or more hours. Hot water dissolves lead more quickly than cold water. Always use cold water. If one needs hot water, draw water from the cold tap and heat it on the stove or in a microwave oven. (3) If one lives in a new home, check faucet screens for the first few months until all small debris are flushed from the system. If lead is found to be a problem in the home, the measures listed above may be all the protection one needs. (4) When a plumber repairs or installs new plumbing, make sure that lead-free solder and lead-free flux are used.

The preceding steps will reduce the lead concentrations in drinking water. However, if a future water test indicates that the drinking water coming from the tap still contains high lead concentrations after flushing, then one may want to consider the option of a home treatment device. Such devices are designed to be installed either to treat all the water as it enters the home (point of entry), or only the water which emanates from a specific site, such as the kitchen faucet (point of use). The home treatment devices that are commercially available for removing lead include reverse osmosis and distillation. The point-of-use devices are limited in that each unit treats only the water that flows from the faucet to which it is connected. They can be purchased or leased and can be expensive. Their effectiveness varies and they must be maintained.

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