WRRC Report No. 120
Lead Profiles in Drinking Water in the District of Columbia: A Background Report

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1.0 Introduction

Lead poisoning remains the most common and devastating environmental disease of young children. The Secretary of Health and Human Services, Dr. Louis Sullivan, has stated that lead exposure is the most important environmental health problem for American children. This report is aimed at providing background information on lead in drinking water, its detection, and measures to be taken to reduce or eliminate it in drinking water. To make people aware of the extent of the lead problem we shall review the nature, historical perspective and current biomedical information on the subject.

2.0 Nature and Historical Perspective

Lead is one of the most common metals that occur naturally in mineral ores found throughout the earth's crusts as lead sulfide (PbS). It belongs to Group IV A of the periodic table. Lead has been known as a metal since at least 4000 B.C. Its chemical symbol, Pb is derived from the latin word Plumbum and it is the root word for the name of the vocation dealing with water pipes - plumber. The metal is readily obtainedby conventional smelting. It is very soft and malleable, and is easily cast, joined, and converted into pipes, sheets or foils. The metal also alloys readily.

For several centuries, humans have used lead for making pipes, ceramics (lining the inside of cookwares and food containers), and paint pigments. Lead compounds make excellent pigments in paints that also weather especially well. Egyptians in the time of the Pharaohs used lead in ornaments and cosmetics. Chalices made of lead-silver alloys were used to carry wine for the ancient Greeks and Romans. Rome was one of the f irst societies to have a piped water supply and lead piping still carries rainwater from the roofs of medieval cathedrals.

Ancient men used lead without understanding its toxic effects. Lead has a great potential for combining with and inhibiting the functioning of enzymes, thereby causing adverse physiological and neurological effects. It has been speculated by some scientists that lead poisoning might we have played a role in the decline and fall of the Roman Empire. The basis for speculation is that only the upper-class citizens of Rome would have had water piped into their homes. Their children drank the water and were exposed to the lead, putting them at high risk for neurotoxicity. Since so many of these children were unable to reach their' full mental potential, and since the upper-class ruled Rome, there developed a scarcity of leadership in the society.

The Romans also added lead salts to sweeten wines. It is again speculated that lead toxicity may explain the bizarre behavior of some of the notorious Roman Emperors.

Many ancient physicians recognized lead poisoning in workers and consumers of lead-based products. Hippocrates described a severe attack of colic in men who extracted metals and recognized lead as a cause of the symptoms. A Greek physician, Nicander, also showed that the stomach pain and constipation experienced after consuming a wine-based syrup suffused with lead were symptoms of lead poisoning or plumbism. The works of Agricola and Paracelsus added to the existing knowledge on lead poisoning during the sixteenth century.

3.0 Health Hazards of Exposure

In recent years, there has been a vigorous new interest in health hazards caused by lead poisoning. The factors accounted for this renewed interest include:

1) An increase in lead use, especially with the development of the automobile industry and great quantities of lead used in the manufacture of car batteries, and in making the lead alkyl compounds which are used as anti-knock additives in gasoline;

2) An increase in the collection of data relative to the incidence of lead poisoning;

3) A better medical understanding of lead hazards and the disease itself; and

4) A change in social attitudes.

Pioneers in the field of industrial health in the early and middle decades of this century considered lead to be harmful at higher levels of exposure. High level lead exposure may cause fatigue, headache, muscular tremor, lack of appetite, and clumsiness. It was also known that high levels of lead exposure affect multiple physiologic functions. The brain and nerves are particularly susceptible to lead poisoning. Lead interferes with several enzymes necessary for hemoglobin synthesis. This results in anemia, decreased reticulocyte count, and basophilic stippling of the red cells. It can also interfere with the functions of the kidneys, the digestive system, vitamin D metabolism, and the reproductive functions in both males and females. It has also been blamed for raising blood pressure in adult males.

There is plenty of evidence to prove the adverse health effects even at low levels of lead exposure. The Environmental Protection Agency (EPA) and the Agency for Toxic Substances and Disease Registry (ATSDR), have stated in policy statements that

lead at low-doses is a serious threat to the central nervous systems of infants and children. Between 1986 and 1988, a large number of studies demonstrated neuro-behavioral impairment in lead exposed children at blood level as low as 10 to 15 ug/dl. Lead may be stored in women's bones from their previous exposure and picked up in increased amounts in their blood stream during pregnancy. Since lead readily crosses the placental barrier, lead carried in the mother's blood is passed to her unborn child. Also, since the contents of a mother's breast milk are largely derived from blood, a breast-fed infant may be similarly at risk. The higher the blood level of a woman during pregnancy, the greater is the likelihood that the baby will be born prematurely, with low birth weight or die in the uterus. Fetal exposure can also cause potential adverse neurological effects in the uterus as well as during postnatal development. ATSDR reported in 1988 that for all standard metropolitan statistical areas (SMAS), more than'400,000 fetuses were exposed to lead through maternal blood lead concentrations associated with early developmental effects in 1984.

In addition to these extremely disturbing findings on the consequences of lead exposure in children and fetuses, a growing body of studies is indicating that low levels of lead also exert toxic effects on adults, including cancer, reproductive effects, and high blood pressure. Factors that may account for children's susceptibility to lead poisoning are:

1) The incomplete development of the blood-brain barrier in very young children increases the risk of lead's entry into developing nervous systems;

2) Children are more exposed to lead than older groups because their normal hand-to-mouth activities introduce many non-food items, such as dust and dirt, into their bodies;

3) Young children absorb and retain more lead than do older children and adults.

Three to four million children in the United States (approximately 17%) are at risk of lead poisoning. A breakdown, according to socio-economic and demographic strata shows that no economic or racial subgroup of children is free from the risk of having blood lead levels high enough to cause adverse health effects. Sizable number of children from families with income well above the poverty level have been reported to have relatively high blood lead levels. The prevalence of elevated levels, nevertheless, remains highest among inner-city, underprivileged children who live in deteriorating pre-1950 housing.

4.0 Sources and Pathways of Lead Exposure

Lead is widely distributed and offers numerous possibilities of chronic exposure. Lead can enter the environment directly, as from industrial sources, or indirectly from incinerated automotive batteries, from lead contaminated household dusts, from gasoline and from drinking water. Because lead accumulates in the body, all sources that add lead to the environment contribute to lead poisoning.

Currently, at least one million tons of lead are consumed per year in the United States. The leading lead mining centers are Missouri, Alaska, Colorado, Idaho, and Montana. Lead may be found in some art and craft supplies, in roofing' materials, in ammunition, and in the lead-acid storage batteries that provide power for electrical systems of automobiles and other vehicles. The major industrial sources alone dispose of or release 15,000 tons of lead waste in the U.S. annually.

In addition to industrial sources, other major sources of metallic lead and its compounds are food, water, paint, and auto exhaust. For children, the most important exposure pathways are chips from lead-painted surfaces, auto emissions, .and drinking water (See Appendix A: "Where Lead Comes From").

4.1 Lead-Based Paint

Lead-based paint presents the most intense exposure hazard to young children and their families. Although current federal regulations have, since 1977, limited the lead content of most paint to 0.06%, the paint in most homes built during the first half of the century contains up to 20-30% lead by dry weight. According to the U.S. Department of Housing and Urban Development, about 57 million residences contain some lead painted surfaces. Of these, 3.8 million private residences present an immediate hazard because of lead paint that is peeling, flaking, and chipping. Children can ingest loose paint as result of pica (compulsive eating of non food items by toddlers) and through mouthing of items containing lead from paint, dust, and soil. Renovation, remodeling, and poor maintenance of old homes are the sources of household dusts.

4.2 Lead in Gasoline

A compound called tetraethyl lead was first added to gasoline in 1923. The lead spewed into the air by automobile emissions may be inhaled directly or settles on to dirt in playgrounds and yards. It enters homes through open doors and windows, covering furniture, toys and pets. Areas alongside heavily travelled urban roads and freeways may have even higher levels of lead in soil and dust.

Federal regulations reduced the amount of lead permitted in gasoline in 1972, and 85% of all gasoline sold in the United States today is lead free: The regulations, however, still allows the use of leaded gasoline in pre-1975 vehicles, and in farm vehicles of any age. It is estimated that leaded gasoline still accounts for about 9% of total of total U.S. gasoline consumption.

4.3 Lead in Food

Lead in food comes from a variety of sources, but the major sources are contaminated environments in which food is grown and processed; contaminated water used in processing; and lead used in packaging and serving vessels, including food or beverages stored in pottery or ceramic dishes. Lead also enters food from lead-soldered cans. Because agricultural vehicles use leaded gasoline, lead can be deposited on and retained by crops, particularly fruits and leafy vegetables.

The American Public Health Association newsletter reported recently that two Columbia University researchers have found that lead crystal, which typically contains 24-32% lead oxide, contaminates alcoholic beverages and juices stored in lead crystal decanters and other crystal containers. After only four months, wine stored in lead crystal decanters contained as-much as 5331 ug/l lead. Lead levels for two brandies stored in lead crystal containers for over 5 years, were 19920 ug/l and 21530 ug/1. Lead in wine served in lead crystal glasses was measured over a four-hour period which revealed a steady increasing lead concentration (ug/1) over time: 33 ug/l (when poured), 68 (after 1 hr), 81 ug/l (after 3 hrs) and 94 ug/l (after 4 hrs). EPA's revised permissible lead levels in drinking water is 15 ug/1.

4.4 Lead in Drinking Water

Lead can be found as a contaminant in drinking water. Lead from drinking water is only one of the sources of lead exposure that contributes to the total amount of lead in humans. on the average, it is estimated that lead in drinking water accounts for 15 to 20 percent of lead exposure in children.

The Agency for Toxic Substances and Disease Registry (ATSDR) has reported that lead from drinking water is absorbed more completely than lead from food; 10 to 15 percent of lead in food is absorbed in adults, but 35 to 50 percent or lead in water is absorbed by children, particularly by infants who drink liquids made with water, such as formula. Combined with other sources, the amount of lead from drinking water, in some cases, could be enough to increase the severity of toxic effects in certain individuals.

4.5 Sources of Lead in Water

Lead gets into drinking water either from the raw water supply (source) or through corrosion. Data on finished water from DC's Dalecarlia treatment plant indicates that lead concentrations are below 2 ppb during most of the year. Its documented that lead can enter surface waters through direct or indirect discharges from industrial or municipal waste water treatment plants or when atmospheric lead settles into water or onto streets and gets into storm waters via rain or snow.

However, lead from these sources is removed or significantly reduced during drinking water treatment processes. The Washington Suburban Sanitary Commission, which distributes drinking water to Montgomery and Prince George's Counties, reports the yearly average of lead levels in finished water to be 0.003 mg/1 and 0.001 mg/1 from the Potomac Water Filtration and the Patuxent Water Filtration Plants, respectively. Also, the Washington Aqueduct Division of the U.S. Army Corps of Engineers, which distributes drinking water to the District of Columbia and parts of Northern Virginia, reports the yearly average of concentrations to be less than 0.002 mg/l for Dalecarlia Water Treatment Plant and for McMillan Water Treatment Plant. The present Maximum Contamination Level (MCL) set by the EPA is 0.5 mg/l.

The primary source of lead in drinking water is the result of the attritive action of water on pipes, fittings, and lead solder. Factors which aid in accelerating this process include:

1. The age of plumbing system

2. The corrosivity of the water (a process by which the lead dissolves or leaches into water). This process is most frequent in soft and acidic water.

3. The amount of lead contained in the plumbing, the faucets, or the apparatuses dispensing water.

Additional factors are:

a. The longer the time that the water has stayed in the plumbing, the more likely that lead builds up in the water.

b. The newer the plumbing, the more likely that lead will be in the water. This is because as plumbing ages, minerals can form a protective barrier between the solder and the water.

c. The grounding of electrical wiring and telephone lines to water pipes can increase the rate of corrosion.

d. Sloppy soldering can result in more lead in contact with water, and thereby increase the amount that is dissolved. Another source of lead in drinking water fountains or water is the lead liners or solder in drinking water fountains or water coolers

having lead-lined tanks. Lead has been widely used in solder and flux in the installation or repair of public water systems and interim plumbing in homes and buildings until the 1986 amendments to the Safe Drinking Water Act (SDWA) and state regulations banned its use.

During the early part of this century, due to its low cost and high durability, lead pipes were used as distribution materials for drinking water in the United States. In some cities, these old water distribution lines could be a source of contamination. It is estimated that approximately 25 to 50 percent of the country's water supplies still have some lead distribution lines. After 1930, copper generally replaced lead as the most commonly used material for water pipes. However, the use of lead solder with copper lines is widespread.

Washington, D.C. officials, at a news conference in 1987, stated that an estimated 71,000 homes and apartment buildings receive their tap water through lead pipes. In a report to the United States Congress in 1988, the ATSDR stated that one Washington, D.C. area child in five may be at chronic risk of lead poisoning. The above statement alarmingly suggest that the District may be a risk area for lead exposure.

The U.S. House of Representatives Sub-Committee[w]on Health and Environment released a report of an independent survey on the safety of drinking water in Capitol Hill during the hearing on the "Lead Contamination Act of 1991 H.R. 2840." The report indicated that water from 21 percent of the coolers and taps tested contained lead levels higher than what EPA considers safe.

After reports of high lead levels in several Northwest Washington houses, the Department of Consumer and Regulatory Affairs contacted a private laboratory in Rockville, to examine water samples taken from those homes. The results indicated that among 84 residences tested in the Palisades area of Northwest Washington, over 13 percent exceeded the proposed federal lead standards of 15 ppb. However, most of the tests were run during midday when lead levels are expected to be lower.

In 1990, the D.C. Department of Public Works commissioned a pilot study of homes likely to have high levels of lead in drinking water because of lead pipes or connection lines. These homes were largely built from the 1920's through early 1940s and are concentrated in wards 3, 4, 5 and 6. The study revealed that 12 percent of the 159 homes tested had levels higher than 15 ppb on the first draw of water from the tap.

Lead concentrations exceeded 50 ppb in several homes and one home in ward 6 had lead levels as high as 128 ppb. The Washington Post reported on March 24, 1986, that Maryland officials had found levels of lead ranging from 10 to 150 times the federal standard in tap water from five houses in Montgomery County. The source of the lead may be solder and flux used to join copper pipes.

It has been reported that Alexandria may have a large number of lead service lines in the Washington suburban area. An estimated 6,000 to 7,000 out of 23,000 water customers get their drinking water from lead service lines. A water test in 1989 showed several homes with lead concentrations exceeding the new EPA standard.

In 1988, the Safe Drinking Water Act was amended ("The Lead Contamination Act of 1988") to require the EPA to provide guidance to states and localities to test for and remedy lead contamination in drinking water in schools and day care centers. The intent was to guarantee minimal exposure of lead to young children. There is lack of information on the state of lead contamination in the District of Columbia public schools. The Montgomery County school system tested electric water coolers in 1988 and found 300 lead contaminated water coolers which were removed from'the schools. One Maryland school district tested all 1,113 of its water coolers and found that 32 percent had test results of 20 ppb or higher. Of those, 76 had lead levels of 100 ppb or higher.

The drinking water in Fairfax County public schools was tested in 1989. 1,133 samples were tested. Thirty-nine samples were in excess of 50 ppb and twenty-four samples were in excess of 20 ppb. The sixty three lead-contaminated water coolers were removed.

5.0 Testing for Lead

The literature suggests that reducing exposure to'lead starts with testing any drinking water for lead, regardless of the type of plumbing material it passes through. The EPA recommends that a plumbing profile will attempt to answer the following questions:

1. When were the buildings, including schools, built?

2. Any new buildings or additions? If so, when were they built?

3. Was lead-free plumbing and soldering used?

4.When were the most recent plumbing repairs made?

5.What is the service connector made of?

6.What are the community's water pipes made of?

7.What materials comprise the solder connecting the pipes?

8.Any brass fittings, faucets or valves

9.Brand and model of water coolers?

10. Signs of corrosion?

11. Is any electrical equipment grounded to the water pipes?

The answers to these questions are important because lead in drinking water is most often a problem in buildings with plumbing that is either very new (less than 5 years old) or very old.

While testing for lead, seasonal variations of lead in water are to be taken into account. This is important because corrosivity is, related to temperature. Warm waters are generally found to be more corrosive, however many factors enter into account, i.e. pH, hardness, etc.

5.1 Water Sampling

Polyethylene bottles with polypropylene caps are used in the sampling of water. A preservative, nitric acid, is used to contain the metal and minimize interference in the test. Samples to be mailed to a lab should not contain nitric acid preservative because it is illegal to send through the mail. Instead, a styrofoam mailing container and cold packs are used. Refrigeration is a suitable preservative until nitric acid can be added to the samples in the laboratory.

Procedure for Water Collection

1. In the morning before any water is used (this includes toilet flashing), open the cold water faucet and immediately fill the first bottle to an inch below the top. Do not splash the preservative out of the bottle. Label it faucet. This sample should hold about 100 ml.

2. Turn the water on. Wait a few seconds, then fill the second bottle and recap it. Label it interior plumbing. This bottle should hold a liter (about a quart) of water to obtain a representative sample of the indoor plumbing.

3. Turn the cold water faucet back on. Wait until the water turns cold. Immediately fill the third bottle and recap it. Label it service line.

4. Let the water run for another 3 minutes and fill the fourth bottle. Recap the bottle. Label it water main.

5.2 Quality Assurance and Quality Control

All sample collection bottle should be acid-washed' and precautions are to be taken to avoid any contamination during collection and analysis. Known standards are to be analyzed along with samples to check the accuracy of the analysis.

6.0 Risk Reduction

Lead is so widely distributed that it is impossible to remove all of it from the environment. However, by taking a few simple precautions, lead exposure can be reduced and thereby minimize the risk of developing lead poisoning in families.

Individuals whose drinking water is suspected or proven to contain lead should be advised to let the water run for about 3 to 5 minutes, if the faucets have been turned off six hours or longer, before using the water for drinking, preparation of breakfast beverages such as coffees, orange juice etc. It is also advisable not to use hot tap water for cooking or drinking because lead dissolves more quickly in hot water than cold. This is especially important when using water for preparing baby formula. Only well-flushed water from the cold tap, heated on the stove, should be used (See Appendix H: Getting the Lead Out: Risks and Costs of Lead in Drinking Water)

7.0 Conclusion

On May 7, 1991, the EPA issued a new rule which qpet "an action level" for lead in first-flush water at the tap (that is, where the water is consumed rather than where it is treated) at 15 ppb. Although the new regulations give treatment plants more responsibility over controlling lead in drinking water, it is the responsibility of the District of Columbia government to protect the public from lead toxicity by commissioning or funding well-designed scientific studies to examine whether the District of Columbia drinking water is contaminated with lead. There is no reliable information on lead concentration in D.C. drinking water supply system including water fountains, coolers and bubblers in the schools and day care centers.

It is recommended that a detailed study including schools, high rise buildings and residences is be conducted. Additionaly efforts should be made to educate the people on the seriousness of lead exposure and various preventative steps.

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Appendices

A. Information Sources

B. Where Lead Comes From

C. Getting the Lead Out: Risks and Costs of Lead in Drinking Water by the Virginia Water Resources Research Center (Extract)

Appendix A

Information Sources

Howard County Office of Consumer Affairs
410-313-7220

Montgomery County Office of Consumer Affairs

301-217-7373

Prince George's County Consumer Protection Commission
301-952-4700

Prince William County-Office of Citizen and Consumer Assistance
703-792-7370

D.C. Department of Consumer and Regulatory Affairs

202-727-7080

Environmental Protection Agency Hotline to answer questions about the quality of drinking water

800-426-4791

Alexandria Citizen Assistance Office
703-338-4350

Arlington County Office of Citizen and Consumer affairs

703-358-3260

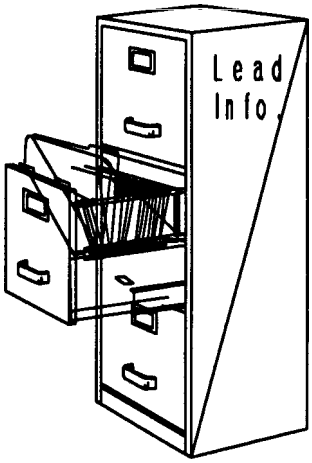
Fairfax County Department of Consumer Affairs

703-222-8435

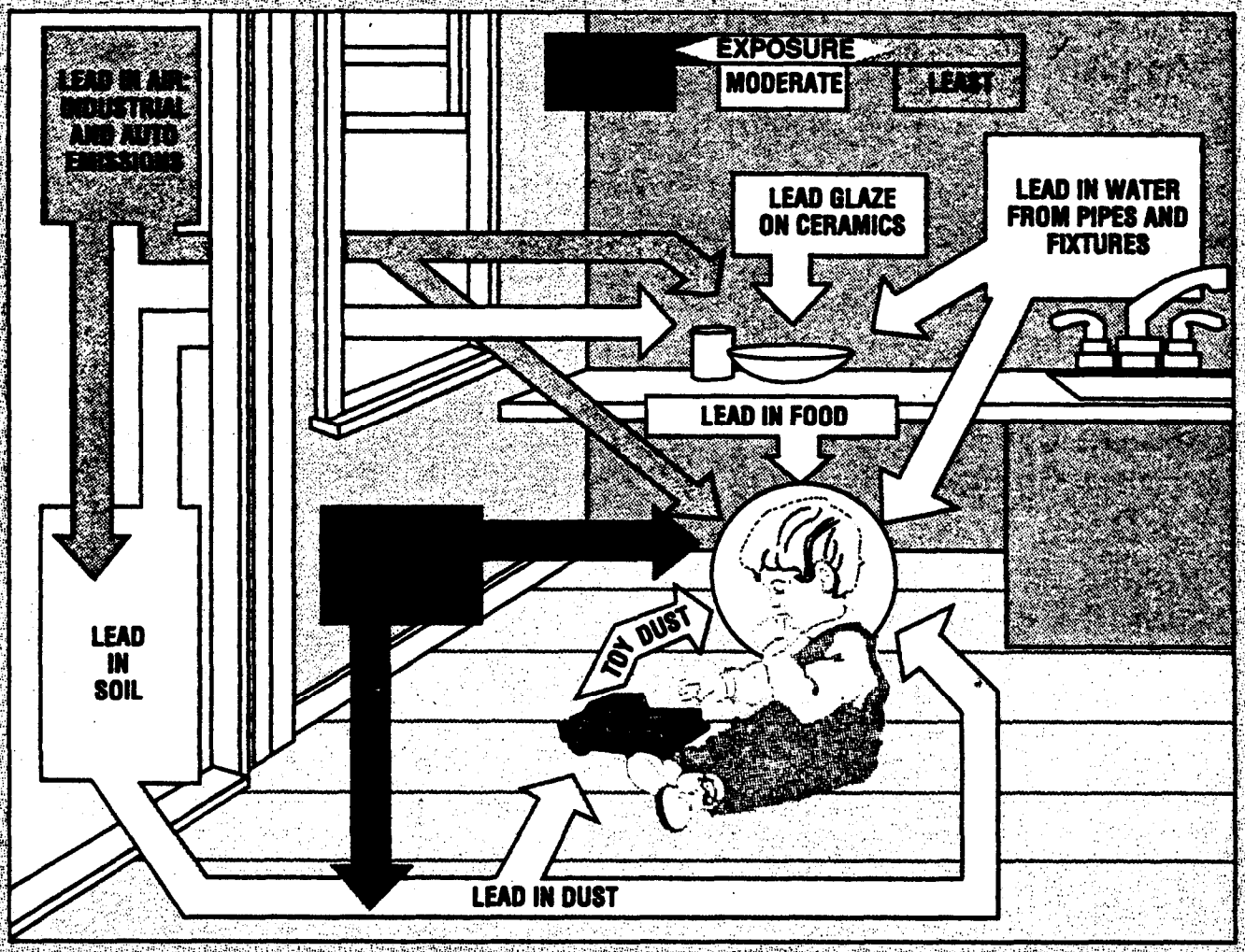
Better Business Bureau of Metropolitan Washington

202-293-8000

Water Suburban Sanitary Commission
(301) 206-8000



WHERE LEAD COMES FROM



The human environment is pervasively contaminated with lead; which finds its way into people's bodies by myriad routes. Lead has been taken out of gasoline, but lead air pollution is still significant near smelters and some waste incinerators. Soil contains lead from decades of atmospheric fallout, especially around traffic arteries and lead-emitting industries: Although lead-soldered cans are gone, lead gets into food from contain soil and water; and from certain lead-glazed ceramic dishware.

The group with the highest risk of lead exposure is young children-especially toddlers, who play in dust and dirt on the floor and on the ground

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Appendix C

Virginia Water Resources Research Center
Virginia Polytechnic Institute and State University 617
North Main Street
Blacksburg, VA 24060

Special Report No. 22 - - June 1991

Getting the Lead Out: Risks and Costs of Lead in Drinking Water

by S. C. Richardson

Lead has been used by humans for centuries; in fact, the English word *plumbing* comes from the Latin word for lead, *plumbum.* However, lead is also a highly toxic metal that produces a wide range of adverse health effects. Although there are several sources of lead contamination, lead in drinking water is one of the most serious. Since lead in drinking water is usually tasteless, odorless and colorless, it can go unnoticed and its poisonous effects remain untreated.

Since Lead in drinking water is usually tasteless, odorless, and colorless, it can go unnoticed

Lead in drinking water, unlike many other water pollutants, usually comes from plumbing at the tap, rather than from polluted ground or surface waters or from public water treatment plants. This potential for lead contamination in household water makes it essential for citizens to become aware of the possible hazard in their homes.

Does Lead Affect Everyone?

Lead is a common metal in the earth, but it poses little risk to humans until it is distributed in our environment through mining and manufacturing. Although lead has long been recognized as poisonous at high dosages, studies on its health impacts in recent years have shown that it can cause damage at lower blood levels than had been realized, and lead exposure levels considered acceptable have been revised steadily downward.' Some of the effects on adults of lead poisoning include:

greater risk of cancer [2]
damage to the brain, kidneys, liver, nervous system, and hearing
inhibited red blood cell formation
elevated blood pressure in adults
increased possibility of stroke [3]

In fact, lead can affect anyone, at any age.

Children Are At Greater Risk

Children and infants are at particular risk from lead, since their growing bodies absorb it more rapidly, and their small size means that a dose of lead is more damaging than to an adult. In 1988, the Public Health Service estimated that 10.4 children in this country were exposed to lead in drinking water." The U.S. Environmental Protection Agency (EPA) has named lead as the most serious environmental health hazard to children because it can cause:'

premature birth and reduced birth weight

anemia, colic, and seizures

nervous disorders and behavioral problems

brain damage and lower IQ levels.[5],

Lead in water keeps more than 240,000 children from realizing their full intellectual potential

EPA has estimated that exposure to lead in water is keeping more than 240,000 children from realizing their full intellectual potential[s]

What Are the Economic Costs?

Since the diverse biological effects of exposure to lead involve all of the bodily systems and multiple types of health problems, medical costs associated with lead damage can be extensive. In addition to direct medical costs, there are significant social costs from lead poisoning. A 1986 study produced by EPA estimated that:

- $291.9 million each year could be saved nationwide by reducing the exposure of adult males to lead, thus reducing high blood pressure, heart attacks, and strokes
- $27.6 million in medical costs would be avoided each year through lower levels of lead exposure in children
- $81.2 million annually would be saved through reducing the need for compensatory education to help children with learning problems caused by lead exposure
- loss of earnings over the lifetime of children who had been exposed to lead, compared those who had not, would be as much as $268.1 million [7]

How Does Lead Get Into Drinking Water?

There are several sources of lead in the environment (see Table 1), although increased regulations in recent years have greatly reduced exposure to lead from these sources.

Drinking water is estimated to contribute 15 to 20 percent of exposure to lead in humans.[$] In addition, lead from water is absorbed more completely than lead from food; 10 to 15 percent of lead in food is absorbed by adults, but 35 to 50 Percent or more, of lead in water is absorbed.

Drinking water may contribute 15 to 20 percent of human exposure to lead

Lead in home drinking water usually comes from solder used to join plumbing pipes or from lead pipes used in some older homes. Amendments to the Safe Drinking Water Act in 1986 banned the use of lead solder, pipes or fittings in public water systems (including those in homes and buildings) after mid-1988.

Significant Sources of Lead

Table 1

Leaded

lead released into the air through weathering and destruction of painted structures

lead ingested by children from household dust or leaded-paint chips

Leaded Gasoline

lead released into air from exhaust

fumes lead released into air during

Stationary Sources

lead released into air by industrial activity, e.g. smelting, refining, battery recycling

occupational exposure of factory workers and exposure of children to lead on the clothing of parents

Dust, soil

paint

industrial activity

gasoline

Water

leaching from lead pipes or solder

lead in water source

Food

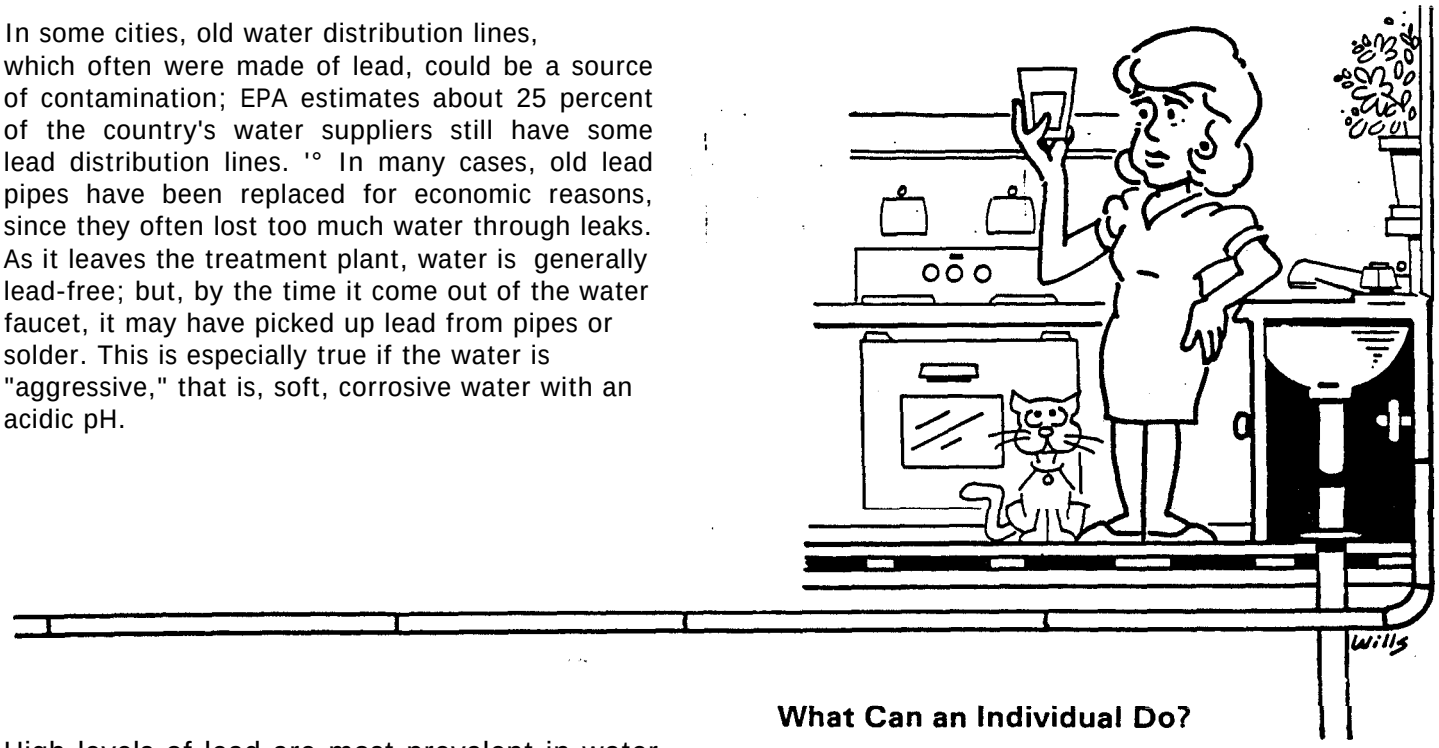
lead in food items from contaminated water or

lead-soldered food cans

lead deposited on crops from automobile exhaust or industrial activity

lead glazes in dishes and pottery

In some cities, old water distribution lines, which often were made of lead, could be a source of contamination; EPA estimates about 25 percent of the country's water suppliers still have some lead distribution lines. '° In many cases, old lead pipes have been replaced for economic reasons, since they often lost too much water through leaks. As it leaves the treatment plant, water is generally lead-free; but, by the time it come out of the water faucet, it may have picked up lead from pipes or solder. This is especially true if the water is "aggressive," that is, soft, corrosive water with an acidic pH.



High levels of lead are most prevalent in water that comes out of the faucet within a few minutes after it has been turned on, since that water has been standing in the pipe for some time. Where copper pipes are used with lead solder, even relatively noncorrosive water can result in high lead levels when water has been in contact with the pipes for more than a few hours.

High levels of lead are most prevalent in first-flush water

Fresh lead-based solder can release high levels of lead into water," but lead leaching into tap water from solder or lead pipes often decreases after two to five years, since natural reactions in the water can create an insulating layer inside the pipes. Virginia's uniform statewide building code has excluded the use of lead-based solder in plumbing since 1986; thus, any plumbing in buildings constructed before that ban may have had time for some protective coating to form inside the pipes.

Drinking water from water coolers is another possible source of lead. The Lead Contamination Control Act of 1988 required the repair or recall of coolers with lead-lined tanks, and prohibited the manufacture and sale of coolers that have lead in their plumbing. EPA has published guidance on lead in school drinking water, as well as a list of water coolers known to contain lead.

What Can an Individual Do?

Test Your Water: Reducing exposure to lead from household drinking water starts with testing the water to find out if there is some risk in your own residence or workplace. Your local health department or water utility can refer you to qualified laboratories; prices for the test may vary from $15 to $25. A list of laboratories certified by Virginia's Division of Consolidated Laboratory Services (DCLS) is also available, either from your local health department.

If tests show that the amount of lead is around 15 parts per billion or higher '4 in first-flush water, EPA advises that the lead level should be reduced as much as possible, particularly if young children are drinking the water. For comparison, you also may want to test the water that comes out after the first flush.

Reducing exposure to lead starts with testing your water

"Flush" Your Water: An immediate step that can be taken is to avoid using water for drinking or cooking if it has been sitting undisturbed in contact with plumbing pipes for six hours or more. In the morning, or after returning home from work, the cold-water faucet should be flushes(by allowing water to run until it has become noticeably colder, usually about one or two minutes (This first-flush

water can be used for rinsing dishes, watering plants, or other nonconsumptive uses.) The water that comes out after flushing the faucet will not have been 'in extended contact with lead pipes or solder, and can be used safely for drinking or cooking. If more than one tap is used for drinking or cooking water, then the water in each of the taps should be flushed. Once the tap has been flushed, water can be stored in bottles for use later in the day to avoid having to flush the taps again.

Use Cold Water for Cooking or Drinking: Another step is to make sure not to use water from the hot-water tap for cooking or drinking, since hot water can dissolve lead more quickly than cold. This is especially important for making baby formula; only well-flushed water from the cold tap, heated on the stove, should be used.

Investigate Your Plumbing: To determine whether the service line connecting a home to the water main is made of lead, you can either hire a licensed plumber to inspect the line or contact the plumbing contractor who installed it. The name of the contractor usually can be found on the building permit, which should be maintained in the locality's files. The plumber also can check the house's plumbing for lead solder or pipe fittings that contain lead.

Private Wells: if lead levels remain high in a house that is served by a private well, the lines or fittings may need to be replaced by the homeowner. *Public Systems:* in areas served by public water systems, high lead levels may require replacement of the lead pipes by the locality. In Virginia, about 4.9 million people get their tapwater from public systems.'

Corrosive water can dissolve lead from plumbing pipes and joints

Measure Corrosivity: Since corrosive water can dissolve lead from pipes and joints, it may be a good idea to measure the corrosiveness of the water. As with lead testing, a private laboratory can measure this for you. Public water suppliers now are required to control the corrosivity of the water leaving the treatment plant, but private wells in some areas may be a source of aggressive water.

In some cases, corrosion may be increased if grounding wires from the electrical system are attached to the water pipes. If your water has a tendency to be corrosive, and if the wiring in your home appears to be grounded on the pipes, the wires should be checked and grounded elsewhere. This should be done only by a licensed electrician, as improper grounding can cause electrical shock and fire hazards.

Use Treatment Devices: If the lead level in your household drinking water is not reduced below 15 parts per billion (ppb) after flushing, then the tapwater may need to be treated directly to reduce the amount of lead it carries. For example, reverse osmosis or distillation devices, which may cost between $300 and $1500, are used ' by many homeowners to ensure that their drinking water is free of contaminants. Neutralizing units, such as calcite filters, can be installed to reduce the corrosivity of the water. Other treatment devices on the market may do little to remove lead from the water; all claims of performance should be investigated. The National Sanitation Foundation tests water treatment units, and their seal of approval should :be displayed on the device.'[6] More information about treatment devices can be found in *What Do the Standards Mean? A Citizen's Guide to Drinking Water Contaminants,* from the Virginia Water Resources Research Center

What is the Environmental Protection Agency Doing About Lead?

The Safe Drinking Water Act, passed in 1974 and amended in 1986, requires EPA to set standards for specific contaminants, including lead. EPA's rule for lead, which was issued on May 7, 1991, set an "action level" for lead in first-flush water at the tap (that is, where the water is consumed rather than where it is treated) at 15 ppb, which corresponds to a 5 ppb, which corresponds to a 5 ppb average in drinking water

With the passage of this new rule, treatment plants across the country must begin new monitoring and treatment programs. All drinking water treatment plants are required to:

- monitor tap water in certain high-risk homes (those with lead pipes, lead service lines, or lead solder installed after 1982)

- submit results to the state agency overseeing drinking water standards (in Virginia, the Department of Health)

Large water treatment plants-those serving more than 50,000 people-are required by the new rule to:

- begin monitoring lead levels *at,* the tap by January 1992

- monitor for other water quality parameters throughout the distribution system (pH, for example), to identify an optimal corrosion control treatment

- begin treatment to control the corrosivity of the public water supply by January 1997

Medium-sized or small treatment plants are given more time before they must begin monitoring. The test results determine whether the plant must take action: if 10 percent of the tests show lead in amounts above the action level of 15 ppb, then these plants also must begin corrosion control treatment. In addition, any public drinking water system that exceeds the lead action levels in tap water samples must carry out a public education program in the community. Table 2 (on the next page) shows the schedule for monitoring and corrosion control programs.

Approximately 600 public water systems in Virginia may exceed the recommended level

Virginia's Public Water Systems

Virginia's Department of Health estimates that approximately 600 water systems in the state may exceed the action level of 15 ppb." The state's largest water treatment plants, whichwill be required to install corrosion control treatment, serve 80 percent of those who receive water from public systems. Although corrosion control in public drinking water was not required by law in the past, 137 systems in Virginia have corrosion-control treatment in place because they are in areas with particularly aggressive water. Other plants raise the pH of their water, which decreases corrosivity, for non-lead-related reasons."

Take individual action in testing and treating your home tap water

It's Up to You

EPA's new regulations give treatment plants more responsibility over controlling lead contamination, and will result in a substantial reduction in the number of people exposed to

EPA estimates that these new regulations will:

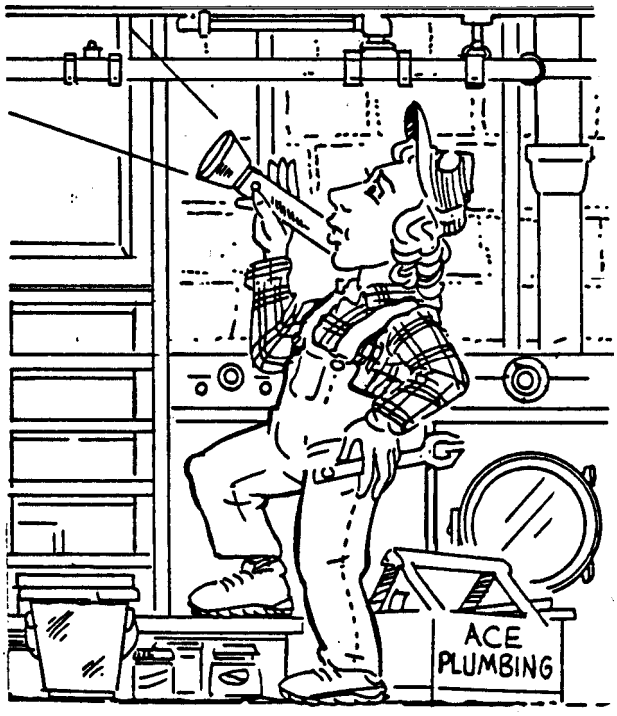
reduce the exposure of approximately 130 million people to lead in drinking water

result in an additional 570,000 children having lead in their blood reduced to a safe level

reduce medical costs estimated between $2.9 and $4.5 billion annually

reduce corrosion in the nation's water supply pipes, making the pipes last much longer, thus saving about $500' million each year .

add a cost per household estimated to range between $1 each year for households served by large systems to between $2 and $20 each year for households served by smaller systems



lead in drinking water. However, the best way to ensure personal protection is to take individual action in testing-and treating, if necessary-your home tap water.