BEN DUMBAULD

Teaching Environmental Science and Civics with Music

SESSION SEVENTEEN

FILTER MATERIAL / ORDER	TEST TYPE	RESULT
Bottom: pebbles, middle: sand, top: charcoal	*pH Turbidity*	*6.5* *6 NTU*

KEY FACTS

Lead is a naturally occurring toxic metal found in the Earth's crust. Its widespread use has resulted in extensive environmental contamination, human exposure and significant public health problems in many parts of the world.

Important sources of environmental contamination include mining, smelting, manufacturing and recycling activities, and in some countries, the continued use of leaded paint, leaded gasoline, and leaded aviation fuel. More than three quarters of global lead consumption is for the manufacture of lead-acid batteries for motor vehicles. Lead is, however, also used in many other products, for example pigments, paints, solder, stained glass, lead crystal glassware, ammunition, ceramic glazes, jewelry, toys and in some cosmetlcs and traditional medicines.

Drinking water delivered through lead pipes or pipes joined with lead solder may contain lead . Much of the lead in global commerce is now obtained from recycling.

Young children are particularly vulnerable to the toxic effects of lead and can suffer profound and permanent adverse health effects, particularly affecting the development of the brain and nervous system. Lead also causes long-term harm in adults, including increased risk of high blood pressure and kidney damage. Exposure of pregnant women to high levels of lead can cause miscarriage, stillbirth, premature birth and low birth weight.

SOURCES AND ROUTES OF EXPOSURE

People can become exposed to lead through occupational and environmental sources. This mainly results from: inhalation of lead particles generated by burning materials containing lead, for example, during smelting, recycling, stripping leaded paint, and using leaded gasoline or leaded aviation fuel; and ingestion of lead-contaminated dust, water (from leaded pipes), and food (from lead-glazed or lead-soldered containers).

An additional source of exposure is the use of certain types of unregulated cosmetics and medicines. High levels of lead have, for example, been reported in certain types of kohl, as well as in some traditional medicines used in countries such as India, Mexico and Vietnam.

CONSUMERS SHOULD THEREFORE TAKE CARE ONLY TO BUY AND USE REGULATED PRODUCTS.

Young children are particularly vulnerable to lead poisoning because they absorb 4-5 times as much ingested lead as adults from a given souce. Moreover, children's innate curiosity and their age-appropriate hand-to-mouth behaviour result in their mouthing and swallowing lead-containing and lead-coated objects, such as contaminated soil or dust and flakes from decaying lead-containing paint. This route of exposure is magnified in children with a psychological disorder called pica (persistent and compulsive cravings to eat non-food items), who may for example, pick away at, and eat, leaded paint from walls, door frames and furniture. Exposure to lead-contaminated soil and dust resulting from battery recycling and mining has caused mass lead poisoning and multiple deaths in young children in Nigeria, Senegal and other countries

Once lead enters the body, it is distributed to organs such as the brain, kidneys, liver and bones. The body stores lead in the teeth and bones where it accumulates over time. Lead stored in bone may be remobilized into the blood during pregnancy, thus exposing the fetus.

Undernourished children are more susceptible to lead because their bodies absorb more lead if other nutrients, such as calcium or iron, are lacking. Children at highest risk are the very young (including the developing fetus) and the impoverished.

HEALTH EFFECTS OF LEAD POISONING ON CHILDREN

Lead exposure can have serious consequences for the health of children. At high levels of exposure, lead attacks the brain and central nervous system to cause coma, convulsions and even death. Children who survive severe lead poisoning may be left with mental retardation and behavioural disorders. At lower levels of exposure that cause no obvious symptoms, and that previously were considered safe, lead is now known to produce a spectrum of injury across multiple body systems. In particular lead can affect children's brain development resulting in reduced intelligence quotient (IQ), behavioural changes such as reduced attention span and increased antisocial behaviour, and reduced educational attainment. Lead exposure also causes anaemia, hypertension, renal impairment immunotoxicity and toxicity to the reproductive organs. The neurological and behavioural effects of lead are believed to be irreversible.

There is no known safe blood lead concentration. But it is known that, as lead exposure increases, the range and severity of symptoms and effects also increases. Even blood lead concentrations as low as 5µg/dL, once thought to be a "safe level" may be associated with decreased intelligence in children, behavioural difficulties, and learning problems.

Encouragingly, the successful phasing out of leaded gasoline in most countries, together with other lead control measures, has resulted in a significant decline in population-level blood lead concentrations. There are now only 3 countries that continue to use leaded fuel (1). More, however, needs to be done regarding the phasing out of lead paint; so far only one third of countries have introduced legally binding controls on lead paint (2).

Back in 2014, Flint water treatment workers expected they'd add corrosion control to the city's drinking water chemicals that would that would have prevented a public health crisis after the city switched its water supply. But the Michigan Department of Environmental Quality said they didn't have to.

Up to this point, it's been hard to understand why the state didn't require Flint to use corrosion control, chemicals that stop lead from leaching into the city's water supply. And the state's rationale, that it misunderstood federal guidelines, has mystified water treatment experts interviewed by the Free Press. It also drew scorn from the Flint Water Advisory Task Force, appointed by Gov. Rick Snyder himselft to investigate the crisis–the task force called MDEQ's interpretation of the rule "egregious" and "lax," saying it bypassed important and obvious questions about water safety.

But testimony at a legislative hearing this week from the city's utilities chief may help explain why: When Flint began to pump drinking water from the Flint River, the city's water treatnnent plant wasn't capable of adding corrosion control treatment, not without equipment upgrades the broke cny couldn't afford.

In fact, Flint didn't start to install the required equipment until Novembe r 2015, when MDEQ signed off on a October permit application for a temporary phosphate feed system while a permanent feed was under construction, according to state records.

That's the same month Snyder finally acknowledged that there was a problem in Flint, that the abundant evidence amassed by independent researchers was accurate, and that the city's drinking water was not safe.

It's critical context for understanding the state's disastrous decision-making in Flint . Michael Glasgow, then a lab supervisor and now the city's utilities administrator, testified Tuesday at a legislative hearing about the Flint water crisis.

The state has said, for months, that MDEQ misinterpreted the federal lead and Copper Rule, a guideline for treating water to prevent the kind of public health crisis that happened in Flint because water pumped from the Flint River hadn't been closed with corrosion control chemicals, the city's residents were exposed to lead-contaminated water, for almost two years, including nearly 9,000 children younger than 6.

And even after the U.S. Environmental Protection Agency told the state last spring that Flint must begin corrosion control immediately, the state didn't act in official emails, claiming it was appropriate to continue monitoring the city's water before changing its treatment, even as two rounds of state testing showed lead levels in the city's drinking water climbing.

The decision to skip corrosion control certainly didn't save money. Corrosion control chemicals, which keep lead contained by coating the inside of plumbing pipes, are cheap; some reports estimate the cost of treating Flint River water at less than $150 a day.

Plant upgrades, however, are expensive. A 2014 engineering report, performed in conjunction with a bond offering for a new regional water authority the state OK'd Flint to join in 2013, said the local treatment plant would require $8 million in upgrades to process the Lake Huron water the new system would pump.

PHOTO FROM WWW.GRIST.ORG CARLOS OSORIO

Flint was broke by the time it joined the new regional water authority, and under the oversight of a state appointed emergency manager hired to cut costs. And it was still broke the next year, when a different emergency manager opted to pull drinking water from the Flint River while the new system was under construction, instead of purchasing water from the Detroit system Flint had patronized for years.

Both choices were billed as cost saving measures, justified because of Flint's financial situation. That 2009 report didn't specify how much of that $8 million total installation of corrosion control equipment would acoount for, but the idea that Flint's plant needed a corrosion control upgrade wasn't new. A 2009 engineering analysis associated with the same water system detailed equipment necessary to add corrosion control at Flint's plant: a 6,000-gallon bulk storage tank, a transfer pump and a 120-gallon day tank and chemical metering pumps.

According to MDEQ, no upgrades to corrosion control equipment were made at the plant before it began to pump and treat Flint River water, more corrosive than the Lake Huron water it expected to use when the new system was complete.

I asked Ari Adler, a spokesman for Gov. Rick Snyder, whether the plant's lack of equipment was a factor in the state's decision to skip corrosion control. Adler stuck with the state's line, that MDEQ misunderstood the Lead and Copper Rule. Nor, Adler said, did the Flint plant's capacity impact the state's decisions in the wake of EPA's order to start corrosion control immediately.

In a series of emails earlier this year, MDEQ spokespeople said the state hadn't required Flint to upgrade its corrosion control equipment because upgrades of its corrosion control equipment weren't required.

It's the kind of circular, maddening illogic that makes parsing the causes and consequence of the Flint water crisis so maddening.

But one thing's sure: As we all work to understand what happened in Flint, the conditions at the water treatment plant and whether the cost of adding equipment impacted public health decisions should be a part of the conversation.