Plumbosolvency exacerbated by Water Fluoridation

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Abstract

Plumbosolvency, the dissolution of metallic Lead, which results in the contamination of drinking water and consequent damage to human health, is recognized as a major problem wherever Lead pipes, solder or brass fittings are present in the supply route. Plumbosolvency is exacerbated by Fluoridation of drinking water. The use of Phosphate in an attempt to reduce the dissolution rate leads to increased costs, waste of a scarce natural resource and environmental degradation. Immediate cessation of neurotoxic Fluoridation to reduce plumbosolvency makes more economic sense. Provision of communal water supplies from point of collection reverse osmosis filters can bring an immediate end to Lead exposure while sources of Lead contamination are gradually removed from the supply network, creating thousands of person years employment in a depressed economy.

Keywords: Crime, Delinquency, Fluoride, Fluoridation, Heart, Hexafluorosilicate, IQ, Lead, Neurotoxin, Phosphate, Plumbosolvency, Stroke

Introduction

The historical use of the malleable metal Lead in plumbing has left a toxic legacy that will cost many nations billions of dollars to remove. In the presence of oxygen, Lead will dissolve slowly with the initial formation of Lead Hydroxide, which readily reacts with other ions. With Carbonate or Chloride, slightly soluble salts form a crust on the metal. The following Table of Solubility shows relative solubilities for some Lead compounds [CRC].

Compound	**Formula**	**Solubility in Cold (20°C) Water** **Gram per litre**
Lead Hexafluorosilicate	$PbSiF_6$	"soluble"
Lead Chloride	$PbCl_2$	0.99
Lead Fluoride	PbF_2	0.64
Lead Fluorochloride	$PbFCl$	0.37
Lead Oxychloride, the mineral Matlockite	$PbCl_2.Pb(OH)_2$	0.0095
Lead Carbonate, the mineral Cerussite	$PbCO_3$	0.0011
Lead Orthophosphate	$Pb_3(PO_4)_2$	0.00014
Basic Lead Carbonate, White Lead	$2PbCO_3.Pb(OH)_2$	"insoluble"
EU 2013 Target		0.00001
USEPA Minimal Risk Level		0.0000001
EU "Goal"		0

The addition of Chlorine to water could in theory reduce leaching by formation of Matlockite, but is more likely to increase leaching of Lead by forming Lead Chloride. Chlorine also leads to formation of Chloramines which enhance leaching of brass, releasing more Lead [Miranda 2006, Switzer 2006, Maas 2007].

Governments until quite recently have been content to "do nothing" about plumbosolvency, however with the advent of the European Union, multinational standards for water safety have emerged and member nations have found themselves confronted with the obligation to try to meet those standards.

The EU set a target of less than 10 micrograms of Lead per litre (10 ppb) to be reached by 2013. The optimum level is Zero ppm.

Adverse Effects of Lead

It took decades of consumer activism to eliminate tetraethyllead from petrol despite decades of scientific proof of harm. Like Fluoride, Lead is bio-accumulative, both being recognized neurotoxins that permanently damage the brain, reducing IQ [Xiang 2003] and can cause behavioural problems. Mullinex [1995] found fluoride more potent than lead in damage to behaviour of experimental animals. Therefore the apparent concern over Lead contamination tends to obscure the neurotoxic hazard of Fluoride in public discussions of water contamination [Xiang 2003]. Recently the United States halved the market for Fluoride by reducing the concentration of Fluoride in US water supplies to 0.7 ppm [Gooch 2015].

Lead increases the severity of dental fluorosis. Increased body load of Lead reduces IQ [Masters 2004, Lamphear], decreases learning ability [Niu 2008, 2009], increases juvenile delinquency, and increases crime rates [Mann 2000]. Fetal death and reduced birth rates are associated with exposure to lead-contaminated drinking water [Edwards 2014].

Lead is also associated with high blood pressure, stroke and heart attacks [Pocock 1998].

Hexafluorosilicate increases Lead leaching

Hydrofluorosilicic acid and its salts are waste products from the phosphate fertilizer industry that cannot be legally dumped on land, surface water, groundwater or the sea. The compound reversibly hydrolyses forming oligomers. Presence of excess silica stabilizes hexafluorosilicate ion and its partial hydrolysis products [Borodin 1974].

Hydrofluorosilicic acid (H_2SiF_6) doubles the number of children with blood Lead (PbB) > 10 mg/dL [Coplan 2007].

The addition of Hydrofluorosilicic acid has been demonstrated to increase the dissolution rate and hence the concentration of Lead in drinking water supplies and this translates directly to higher Lead blood levels and associated human damage [Masters 2000, Allegood 2005, Clabby 2006 and Miranda 2006, discussed in Maas 2007].

This occurs because Hexafluorosilicate can form complex ions with Lead ions (coordination number up to nine) via bridging Fluorine atoms in solution [Bonomi 2001, Burt 2015, Cole 1981]. Stable Hexafluorosilicate compounds are readily obtained from aqueous solution [Conley 2002, Gelmboldt 2007, Burt 2015].

Rapid ion exchange causes shifts in 19F NMR measurements and has led some researchers to mistakenly state that hydrolysis of hexafluorosilicate is "complete" in water. However the fact that Si-F coupling constants are observed at low temperature confirms attachment of F to Si under mild conditions [Borodin 1974, Conley 2002].

There is also a little studied Pentafluorosilicate ion SiF_5^- that is present at pH below 3.5 [Finney 2006]. The hydrated ion $[SiF_5(H_2O)]^-$ and the neutral intermediate *trans*-$[SiF_4(H_2O)_2]$ have been successfully isolated in stable solids [Gelmboldt 2007]. The stability of complex fluoride ions of silicon is enhanced by the fact that the Si-F bond is much stronger than the Si-O bond [CRC]. The toxicology of these fluorosilicate species has not been widely reported [Rice 2014], and perhaps even suppressed. According to one study "No carcinogenicity studies have been conducted using (hydro)fluorosilicic acid, sodium silicofluoride, disodium hexafluorosilicate or hexafluorosilicate or hexafluorosilicic acid." [European Commission 2010].

Hydrofluorosilicic acid is a more powerful inhibitor of acetylcholinesterase than Sodium Fluoride (NaF) [Westendorf 1975, cited in Coplan 2007].

Use of Phosphate in attempts to reduce Plumbosolvency

Some water suppliers have added Orthophosphate in an attempt to counter the leaching by formation of a thin coating of Lead Orthophosphate inside the pipes [Comber 2011]. However reference to the Table of Solubility above shows that, assuming saturated conditions, the EU target will clearly not be met by this treatment because any Lead Phosphate in the pipes has plenty of time to dissolve to reach saturation when the water is not flowing.

Phosphorus is essential to life but is a rapidly diminishing natural resource and should therefore be conserved for food production. Given that 99% of the added Phosphate will not be consumed by humans, the economic and environmental folly of this approach is exposed.

When excess Phosphorus is released to the environment, algal blooms can occur that damage the ecology and dosing concentrations commonly used in attempts to reduce plumbosolvency are up to 30 times those allowed in UK rivers [Gooddy 2015].

Phosphate sources commonly used are Phosphoric Acid or Monosodium dihydrogenphosphate (about seven times the cost of the acid). Zinc phosphates would be too toxic to contemplate. It has been found that some Polyphosphate chemicals actually increase Lead mobilization [Edwards and McNiell 2002 cited in Maas 2007].

All Phosphate sources are contaminated with toxic and carcinogenic elements including Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, and Zinc. Clearly the addition of Phosphate increases risk to human health.

In a 2003 study of orthophosphate dosing [Jackson 2003], there was a statistically marginal reduction of measured Lead in only 3 out of 5 properties tested, however the fundamental flaw of that study was failure to monitor temperature on sample collection. Following poor results with orthophosphate a 2011 report [UK Water 2011] discussed the options for finding alternative strategies and briefly mentioned introduction of pipe liners. The economic model included an estimate of extra costs at waste water treatment plants to cope with the excess phosphate but failed to include environmental impact and associated costs of dumping phosphate in rivers.

A recent study of orthophosphate dosing performed for the Government of Alberta, Canada, concluded that the most cost-effective approach for Calgary is an accelerated programme of total pipe replacement, while orthophosphate will delay the inevitable need to replace pipes in Edmonton [Hayes 2014].

Plumbosolvency Lead Hazard Reduction by Cessation of Fluoridation

Studies in two US cities, Tacoma, Washington and Thurmont, Maryland, found an immediate reduction of Lead concentration when Fluoridation was stopped. In Tacoma the level dropped from 32 parts per billion (ppb) to 17 ppb and in Thurmont from 30 ppb to 7 ppb, that is below the 2013 EU target level [cited in Maas 2007].

Recommended actions and alternative Strategy

Considering the available information, the following actions could partially ameliorate the Plumbosolvency threat from supply networks:

- Immediate cessation of Fluoridation
- no addition of Phosphates
- minimal use of Chlorine
- use Ozone instead of Chlorine
- adjustment of pH with the least contaminating alkali available
- acceleration of Lead pipe replacement

Replacement of piping in the distribution network and customer premises will take time, generating much new employment and net economic growth. The improvement in human health could be assigned a monetary value.

In order to more rapidly remove this dangerous Lead exposure from the entire affected population, namely those who drink distributed system water, I suggest <u>an alternative strategy</u>.

As 99% of the system water is not consumed, it would be economically feasible to deliver reverse osmosis pure water at community taps so that each family could collect a few litres of water per day for drinking and cooking.

The installation requires a small footprint, could be powered by renewable energy and would need a small holding tank while producing pure water by pressure sensing pump on demand. Citizens would be advised to refill their own approved container, avoiding plastic waste.

This strategy has been implemented in New Zealand by communities that reject deliberate poisoning of water with Fluoride, enabling them to opt out at almost no cost apart from transport to the supply point. People are happy to meet at the clean water tap, similar to distribution of hot water in poorer areas of Scotland, prior to the Thatcher era.

It would be worthwhile if all water providers immediately installed a number of these facilities for a demonstration and trial of community acceptance while explaining the real and present danger of Lead poisoning wherever plumbosolvency occurs.

Hopefully the international attention currently being brought to plumbosolvency will see more governments making the decision to cease fluoridation of water (as did Israel in 2014) to remove another neurotoxic hazard.

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