



Lab INTERNATIONAL

SERVING ANALYTICAL & LABORATORY SCIENTISTS IN CHEMISTRY,
PHARMA, ENVIRONMENTAL TESTING, FOOD ANALYSIS.

Biotesting of water: bead-based microsensors on fibre optic microarrays

SHRINKY DINK MICROFLUIDICS

Lab-on-a-chip construction made simple
by thermoformable plastics

TESTING MICROBIOLOGICAL LOAD IN FOOD

immunomagnetic enrichment improves sensitivity

METALLIC LEAD IN POTABLE WATER

tap water even better with a filter

If undeliverable, return to: PanGlobal Media - 100 rue des Palais - B-1030 Brussels - Belgium



New Easy Field Lead (Pb²⁺) Test

Industrial Test Systems, Inc. | www.sensafe.com

4 Minute Test with 3 µg/L Detection.

Read article about this test inside P. 17-19

Visit us at PITTCON, Booth # 5130 | Visit us at Analytica, Booth # A1-550





Lead in the environment and in drinking water

by Ivars Jaunakais



The president of water test kit manufacturer Industrial Test Systems, Ivars Jaunakais, is passionate about drinking water quality. Taking advantage of the fact that the kits his company produces are easy to use and sensitive, Ivars has been conducting a personal campaign over the last few months in which he tests the lead levels in potable tap water from any taps that he comes across in the course of his day-to-day business and private activities. The results are striking, showing that we should still take simple precautions before we drink tap water.

Everywhere you look metal lead is in the headlines. The majority of the recent press attention, however, has not focused on lead in contaminated water, air, or soil but rather on high concentrations of lead found in toys and children's jewelry that have been produced in developing countries where lax standards apply. Regardless of the particular source of lead contamination, the fact is lead can give rise to a variety of adverse health effects, particularly in children where it can provoke retardation in both physical and mental development. In adults, lead consumption can cause elevated blood pressure and prolonged intake can result in the development of renal problems. The potentially devastating effect of lead intake in children is most concerning. Aggravating the fear among the general public is the realization that lead poisoning is not new, which in itself gives rise to the question as to how modern, technologically developed countries and societies tolerate the fact that there is still a real and present danger from lead.

☐ Sources of lead pollution

In fact the problem relates to the huge and ubiquitous use of lead over the last two centuries. Most of us are aware that although new paint containing lead is now outlawed, old homes are still contaminated with lead paint. In the Western world, if a house or flat was built more than fifty years ago there is most probably some lead in either the interior or exterior of the construction. In addition to lead in paint, everyone is aware of old water pipes containing lead or even copper pipes whose solder contains lead. Other potential sources of lead in the environment are car batteries, which are often taken for granted but can be, depending on the methods used for their disposal, a significant source

of lead in the environment. And while at least one old source of lead pollution, namely the solder in tins and cans containing food, has been definitively stopped, the reality is that despite our awareness of its dangers, lead is still omnipresent in our environment.

The practical consequence of this is that the risk of lead finding its way into our domestic water supply is still very high. The question this raises is all the more important given the current controversy about the ecological impact of the current fashion for drinking bottled water. The argument is that instead of trucking large volumes of drinking water from some spa source or another over large distances, it would be much preferable environmentally (and much cheaper too!) to simply drink local tap water. This argument is of course only valid if the quality of the local tap water is acceptable.

☐ Lead in tap water

To get at least an anecdotal feel for the size of the problem of lead in tap water, for the last few months I have been carrying out a personal campaign in which I measure lead in water from as many taps as I come across in my daily business and personal activities. In addition to measuring the tap water itself, the recent publication by Triantafyllidou *et al*, [1] prompted me to test not only any particles trapped on the aerator filters fitted on most taps but also the nozzle itself, which holds the filter [Figure 1].

☐ Testing principles and methods

All testing was carried out with the LEADQuick test from ITS using Hach's LeadTrak Pocket Colorimeter II. The LEADQuick test involves acidification of the water or the solid sample by the addition of a Pb-1 acid reagent and waiting

for two minutes to allow the acid to solubilise the lead into Pb^{2+} . The next step involves addition of the Pb-2 Buffer which makes the solution alkaline (approx. pH 9.4). Then the eXact Strip P is dipped in the test solution for 20 seconds with a gentle shaking motion. This process introduces into the solution the porphyrin lead indicator, porphyrin 5,10,15,20-terakis (1-methylpyridinium-4-yl) phorphine, known generally



Figure 1. Recent studies have shown that the aerator filters fitted to many taps can entrap small dislodged particles containing lead. Even the nozzles used to hold the filter contain lead.

Sink and Tap Location	Extracted Lead in Water ug/L	Extracted Lead in Particles ug/L	Extracted Lead in Nozzle ug/L
Business Men's Room	< 3	190	135
Business Women's Room	< 3	19	90
Business Lunch Room	< 3	52	195
My Home Guest Bathroom	< 3	15	80
My Home Bathroom	< 3	11	115
Daughter's Home Bathroom	< 3	< 3	230
Associate's Home Bathroom	59	< 3*	430
Banff, Canada Hotel Bathroom	< 3	25	NT
Edmonton, Canada Hotel Bathroom	< 3	63	NT
Barcelona, Spain #1Hotel Bathroom	<3	12	163
Barcelona, Spain #2Hotel Bathroom	<3	104	28
Nozzle/Aerator bought in USA	NA	<3	125
Nozzle/Aerator bought in Spain	NA	<3	420
Deionised water (Blank control)	< 3	NA	NA
Lead Free Fixture (nozzle)	NA	NA	< 3

*interference suspected since precipitate appeared during testing; but test reported below detection level of Lead (< 3)

Table 1. Samples tested by Ivars Jaunakais over the last few months and his results.

as TMPYP. After one minute a coloured complex is formed by the porphyrin reagent and Pb²⁺. At this stage the LeadTrak meter is zeroed in the “abs” mode and without disturbing or moving the test cell from the meter measuring window, the eXact Strip Pb-4 is dipped into the cell sample for twenty seconds with gentle motion. This motion mixes the solution and releases EDTA into the sample, so breaking up the coloured porphyrin-Pb²⁺ complex. After 1 minute, the absorbance reading enables determination of the lead present, with a conversion chart being used to transform the raw absorbance data into the concentration of lead, expressed as ug/L or ppb (parts per billion). Since the measuring cell itself is used for carrying out the reactions there is no need to remove the cell from the meter between the zeroing and final reading step. The overall test system is both accurate and sensitive.

In practice, the lead from the particles trapped on the aerator filter was measured by carefully transferring any solid material on the filter into a small beaker using only plastic utensils to avoid contamination. Three drops of Pb-1 solution were added and acid extraction carried out for five minutes. Ten mL deionised water were added to the beaker and the liquid decanted to the measuring cell for the remaining steps of



The LeadQuick test is easy to use and sensitive. With the Pocket colorimeter, the system is easily transportable and can thus be used for the testing of any water samples met in the course of normal day-to-day activities.

the test to be carried out. Lead in the tap nozzle that is used to hold the filter was extracted and tested similarly.

Mercury and cadmium can in principle also react with the TMPYP reagent in a similar way to form a coloured complex. This however only occurs at high concentrations of the metals, so that in practice mercury and cadmium are rarely found in tap water or in metal fixtures at concentrations that would interfere in the test for lead.

Results

Water samples. Reassuringly, it can be seen from Table 1 that only one of the eleven water samples was found to contain lead at a level above the 15 ug/L level allowed by the US EPA or the 10 ug/L allowed by the WHO. This high level could have been expected since the water sample tested was taken from the first 100 mL water drawn from the tap after more than 12 hours of previous stagnation in the pipes. Appropriate flushing and discarding of the stagnant water avoids exposure to the high level of lead. Another alternative is simply to always draw the water from the tap into a pitcher fitted with an appropriate carbon filter approved for lead removal prior to drinking the water.

Particle samples. In contrast, of the nine particle or sediment samples trapped on the aerator filters that were tested, only two were found to be lead-free [Table 1]. This finding agrees with the results of other research studies, namely that solid sediment particles that are trapped on the water aerator screen can be significant contributing sources of the lead found in tap water. This reinforces the importance of fitting point-of-use (POU) filtering devices on all taps that will be used for drinking water.

Nozzles. The data in Table 1 show that the

metal nozzle that holds the aerator filter screens also contains lead. Even two brand-new nozzles bought in modern home improvement stores in Spain and the United States were found to be positive for lead. The filter screens themselves are however constructed predominantly from stainless steel; these tested negative for lead using the five minute extraction procedure described above.



For the last few months, Ivars Jaunakais has been testing the water from all the taps he comes across in the course of his daily activities.

Conclusion

Although the current study was carried out only on samples that I encountered at random during my business and private day-to-day activities, there is a strong take-home message from all this, namely that we are exposed to more lead in the environment, (particularly in drinking water) than we think. Especially shocking is that even newly purchased tap nozzles contain lead. In fact only the control tap that was clearly labelled “Meets California Prop 65 and NSF/ANSI 61 lead-free standards” was found to be lead-free of the nozzles which I tested.

Life-style changes

From the results of my personal study into lead in drinking water, I have already made several changes in my life style:

1. I believe in drinking tap water but only if it is micro-filtered to remove the small lead-containing particles.
2. I use a charcoal filter that will remove any lead that may leach from the nozzle or other plumbing fixture.
3. I do not allow children to drink directly from the tap nozzle since the metal from which it is made will most likely contain lead.

References

1. Triantafyllidou *et al* “Lead particles in potable water,” Journal AWWA, June 2007.

The author

Ivars Jaunakais is the founder, chief analytical chemist and president of Industrial Test Systems, Inc., Rock Hill, South Carolina, USA. • www.sensafe.com