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Food, Water & Lead Contamination

Contents

Editorial: Pectin as a panacea against lead; lead contamination in our food and water

Do you know that the food we take and water we drink could be contaminated with lead and you could be unknowingly suffering from lead poisoning?

Summary

It looks like lead is an omnipresent agent, could be present anywhere. The current concern is its presence in our food and drinking water. Subothini looked at consequences of the lead to human body and its management; she suggests that pectin, a common gelling agent, and its modified form could be useful in lead elimination from the environment and our body.

Giblin looks at the various mode of lead contamination in our food that is more common in third world countries with lower food standards. However, lead contamination of food is seen all around the world despite having strong food standards as a result of the food import and export system one downside of "free trade." The contamination begins at the developmental stage of plants grown in soil with high levels of lead. This not only contaminates food crops but also the bodies of grazing animals.

That leads to our next topic, fertilizers (Biosolids) as a lead contaminant in soil, especially concerning higher lead contamination in China, the country selling cheaper food around the world.

Pectin: Panacea for both lead poisoning and lead contamination

By Subothini Srikaran, Intern at The LEAD Group, Summer 2009-10

Please note that a factsheet version of this article can be found at www.lead.org.au/fs/fst57.html

Lead and Lead Contamination

Lead (Pb) is a heavy metal, which has a bluish-white colour when freshly cut, turns into a dull grayish colour upon exposure to air and has a shiny chrome silver luster when melted into a liquid. It is readily available, cheap, soft and malleable. For this reason, lead and lead compounds are being used in wide range of products such as building constructions, paints, ceramics, pipes, solders, gasoline, batteries and cosmetics[1].

Lead is a poisonous metal. Lead ions are being released into the environment due to industrial activity and technological development. This poses a significant threat to the environment and public health because of toxicity, incremental accumulation in the food chain and persistence in the ecosystem. The most common sources of lead are lead-based paint, contaminated soil, household dust, drinking water, lead-glazed pottery[14] and the effluents of industrial wastewaters. Activities such as smelting, mining and agriculture have lead to contamination of soils with lead and other heavy metals in many areas of Australasia and other continents. Soils rich in heavy metals such as lead create a possible risk to human health if directly ingested or if metal(loids) are transported through food. Furthermore elevated levels of heavy metals in soil are also known to have adverse effects on micro-fauna and flora and higher order plant life at contaminated sites[4] Hence, it is vital to efficiently remove before it reach to environment and food, especially from wastewater[1]. This not only assures lead free environment but also helps to protect natural resources[3].

Lead has been removed from gasoline, household paint, solder and other consumer products which resulted in a significant decrease in environmental lead concentrations. However humans are still exposed to low levels of lead through contaminated food, water, dust, soil and occupational activities[5] In adults the common cause of lead poisoning is occupational exposure whereas in children the main cause is lead paint, found in many homes particularly old ones. Other routes of lead exposure are contaminated air, water, soil, food and consumer products.

Lead Poisoning

Lead interferes with various body processes and is toxic to organs such as heart, bones, intestines and kidneys; it also interferes in reproductive and nervous systems. It is predominantly toxic to children, because it interferes with the development of the nervous system thereby results in potentially permanent learning and behavior disorders.

Elevated levels of the lead in the body results in a medical condition known as ***lead poisoning***. Lead poisoning could be either acute or chronic. Acute lead poisoning is caused by intense exposure of short duration whereas chronic lead poisoning is the result of repeated low-level exposure over an extended time. The lead toxicity is determined by both the quantity of lead in the blood and tissues and also the time course of exposure. Even at lower levels lead may impair development and have harmful health effects hence there is known safe exposure level. The amount of lead in the blood is measured in micrograms of lead per deciliter of blood (µg/dL) for the diagnosis and treatment of lead exposure.

According to The US Centres for Disease Control and Prevention and The World Health Organization, a blood lead level of 10µg/dL or above is considered to be a cause for concern.

Management of lead poisoning

The management for lead poisoning includes its removal from the source and maintaining the nutritional health. It could be managed with the treatment of iron, calcium and zinc deficiencies that are associated with increased lead absorption. If materials consisting lead are found in the gastrointestinal tract whole bowel irrigation, cathartics, endoscopy or surgical removal may be utilized to remove it from the gut and avoid further exposure. Bullets consisting of lead and shrapnel may also pose a danger of further exposure and may have to be surgically removed if they are in or near fluid filled or synovial spaces. In the case of lead encephalopathy, anticonvulsants may be provided to control seizures, and treatments of corticosteroids and mannitol to control swelling of the brain. Organic lead poisoning can be treated by eliminating the lead compound from the skin, avoiding further exposure, treating seizures. And for the people with higher lead concentration, a chelation therapy could be used. This therapy is based on the use of chelating agent; a molecule with at least two negatively charged groups which enables it to generate complexes with metal ions with multiple positive charges such as lead. The chelate formed as a result of this process is non toxic and can be excreted in the urine, initially at up to 50 times the normal rate[6].

The chelation therapy had been used for the treatment of heavy metal poisoning. Numerous chelating agents had been used in the therapy. The first chelating agent dimercaprol (Bristish Anti-Lewisite, BAL) was introduced during World War I for the treatment of arsenic-based poisonous gas (lewisite)[15]. Its successful application resulted in to introduction of several other chelating agents such as [15]

- Alpha lipoic acid (ALA)
- Aminiphenoxyethane-tetraacetic acid (BAPTA)
- Deferasirox
- Deferiprone
- Deferoxamine
- Diethylene triamine pentaacetice acid (DTPA)
- Dimercapto-propane sulphonate (DMPS)
- Dimercaptosuccinic acid (DMSA)
- Ethylenediamine tetraacetic acid (calcium disodium versante) ($CaNa_2$-EDTA)
- Ethylene glycol tetraacetic acid (EGTA)
- D-penicillamine

Among these EDTA and DMSA had been used in lead intoxication. But treatment with these chelators required continuous monitoring as they could bind with vital minerals (along with lead) from the body and could cause various adverse reactions. Moreover they are mostly administered intravenously and tend to be unsafe in children. [10] The search for the safe chelating agent had finally resulted into study of pectin in chelation therapy.

Pectin in Chelation therapy

Pectin is a structural heteropolysaccharide found in the cell walls of terrestrial plants. It is predominantly extracted from citrus fruits and is produced commercially as a white to light brown powder and is utilized in food as a gelling agent especially in jams and jellies[7]. Khotimchenko et. al. have demonstrated that pectin substances are capable of binding heavy metals especially lead. Many pectin-rich by-products such as apple waste, sugar beet

pulp, orange peels, orange and banana peels, citrus peels and coffee husks have been studied for their metal binding capability (biosorption) [2], which had been found to be cost effective alternative compared to traditional metal removal methods such as chemical precipitation and filtration, redox reactions, electrochemical treatments, reverse osmosis, ion exchange, adsorption and evaporation[9]. In addition it is also ideal for the purification of effluents with low metal concentrations. Schiewer et al suggests that orange peels could be used for lead ion biosorption but needed further studies for its practical use. Similarly, sugar-beet pectin had been used as an effective biosorbent for the treatment and recovery of Pb from wastewater. Sugar-beet pectin is derived from sugar-beet pulp, a residue of the sugar processing industry. It has an advantage over pectin derived from other sources as it is found in dry form [4].

Some biosorbents have the property of passively binding metals on chemically active sites or functional groups. The extent of metal uptake by pectin is determined by its chemical structure and found to be increased with decrease in the degree of esterification[8].The cell wall of pectin is made up of three pectic polysaccharides namely homogalacturonan, rhamnogalaturonan-I (RG-I) and substituted galacturonans (rhamnogalacturonan –II or RG-II). Among these RG-II had shown an immuno- modulating activities and binding capacity with heavy metals[17] and have been studied extenively for the metal removal from environment (biosorption) as well as from our body (chelation). Tahiri et al suggested that dimer of RG-II (dRG-II) was specific and efficient in forming a complex with lead and therefore could be utilized to reduce intestinal absorption and accumulation of lead[2]. The pectin-vitamin preparation (PVP, 3-4g daily for one month) had been used as prophylactic measures in industrial workers with prolong lead exposures and found to be effective against chronic lead poisoning. [18] In other studies, chemically altered form of pectin, known as modified citrus pectin (MCP) had been used as chelator. MCP is a purified component of standard citrus pectin that is officially identified as generally regarded as safe (GRAS). MCP is a nutritional supplement derivative of the inner white pulp of citrus fruit peels. It had been shown that MCP is capable of binding toxic heavy metals and excreting them without perturbing the vital minerals in healthy humans. This is because MCP has the ideal structure for chelation of heavy metals; it contains approximately 10% rhamnogalacturonan II than enhances the ability of pectin to bind heavy metals rather than essential mineral cations. MCP used in the study by Zhao et al is made up of citrus pectin which has been broken down into shorter chain molecules and decreased side chain through the use of enzymes and variation in PH. The lower molecular weight of this compound enhances absorption into the bloodstream and the decreased esterification enables the molecule to bind to cations. In this study administration of MCP as the sole chelating agent to hospitalized children five to twelve years of age resulted in a huge increase in urinary excretion of lead and a significant reduction in blood lead levels[9]. In another study low esterified pectin has been demonstrated to promote a significant improvement of thyroid function in rats with thyroid gland pathology as a result of lead injections. In addition lead content in the livers of rats treated with pectin was significantly lower than in untreated animals[10].

Conclusion

The studies have shown pectin could be used in chelation therapy for the treatment of lead poisoning. Various modified form of pectin had been used for lead elimination from both environment and our body. Nevertheless, further studies in rats and humans are needed prior to developing pectin as a preventive or maybe as a curative agent in Pb exposure and toxicity in humans.

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Lead Contamination of Food

By Alex Giblin, Intern, The LEAD Group, Australia, 4 June 2010.
Edited by Monica Maharjan, Robert Taylor and Anne Roberts

Lead contamination of food is more common in third world countries that do not have strong food standards. It has recently become an issue in countries that have been importing food products from such countries. Food can become contaminated where it is grown, or by cooking vessels or the containers in which it is exported or stored.

There have been many 'lead scare' news stories involving recalling products due to lead contamination. In 2005 the New Zealand Food Safety Authority recalled a brand of baby custard and a number of brands of cornflour that were imported from China, due to 'unacceptably high' levels of lead. [1] In May of 2008, lead was discovered in a piggery feed supplement, imported from China, at Linley Valley abattoir of Western Australia. This resulted in the quarantining of several piggeries. The W.A. Department of Health found that the lead accumulation in the pig meat was in the liver, kidneys and bones, and could pose a risk if sold on the bone. In the United States, on August 3, 2007, beverage containers and glass water tanks were recalled, of which approximately 12,592 had been sold from May 2005 to July 2007, from a chain of stores. [2] The containers used for acidic beverages had a metal spigot containing lead, which leached out into the liquors. A number of other drinking vessels containing lead or decorated with paint containing lead have been recalled in the United States in recent years. Similarly, in the United States in March 2009, a recall was issued of approximately 2500 cordless kettles because they leached lead into boiling water. [3] Lead contamination of food has also occurred in the process of countries' production of food intended for local consumption: in Oregon, U.S.A., in 2006, a chocolate manufacturer recalled a range of organic chocolate bars as they contained high levels of lead. [4]

In March 2010, certain chocolate products from Darrell Lea Chocolate Shops Pty Ltd were recalled, due to trace elements of lead above the accepted Australian standard. Contamination occurred due to a third party source. The product was recalled in Australia, New Zealand, The U.K. and U.S.A.

This is by no means a complete list; food products contamination extends beyond the small number of examples given above.

There are a number of ways in which lead contamination of food occurs. The most common way has been during the growth and development of plants grown in soil containing an unusually high amount of lead. The plant surfaces become contaminated with dust or soil, or the plants may take up the lead from the soil as they mature. Lead contamination of food can and does occur even in commercial farming. The lead contamination of soil occurs when lead, lead dust, biosolids (sewage sludge), fertilisers made from waste acids from lead smelters or any liquid containing lead is introduced to the soil. Improperly lined lead soldered cans or plastics with leaded paint or ink can also result in lead contamination of food. [5] Lead contamination can also occur when food is stored, served, or heated in any vessel which contains lead – including any decorated with paint or poorly fired ceramic glaze which contains lead. Additionally, some food cans, sold even today, may be sealed with lead solder; easily recognisable for their irregular shape, a thick seam and horizontal depressions as compared to non-lead can with a flat-welded seam.

Similarly, lead may be present in meat, as cattle may ingest lead as they graze, feeding on grasses and plants which have grown in soils with unusually high in lead due to sump oil, lead batteries, paint chips, discarded paint tins, scrap lead, [6] and a number of other items containing lead that are used for running a farm but not always safely disposed of. It has been found that cattle are attracted to contaminated plants because of their sweet taste. [7]

Lead contamination of food, which occurs in both developed and developing nations, poses a serious health issue. Consumption of even a small amount of lead can cause lifelong health problems and repeated exposure will have lasting and detrimental effects. If a woman is carrying a child or breastfeeding and has heightened lead levels, this will also pose a problem. The study had found that about 1-5% of mother's lead level will likely be present in her breast milk and will pass on to her child. Even if it has been some time since the mother came into contact with lead, the lead may be stored in her bones and be released in her breast milk, usually at very low levels. [8] Similarly, lead may be transferred through the placenta. [9] It must be emphasised that exposure to lead in breast milk has a smaller effect on infant lead levels than the cumulative exposure of the foetus during pregnancy. [10] This is of particular concern as unborn babies, infants and young children are more susceptible than adults to the lasting effects of lead consumption [11] – particularly the degenerative effects on cognition.

However, it should be noted that breast milk is still the best food for a child. If the mother is concerned about her lead level, it is best to ask a doctor/obstetrician to test her blood lead level and, if it's elevated, attempt to reduce it through identification and elimination of the sources of lead, plus improved nutrition. As a preventative measure, eating certain foods -

chiefly those which are high in calcium, iron and Vitamin C [12] - can lessen the absorption of lead into the body,

For more information on breastfeeding if you suspect yourself of having elevated lead levels refer to www.lead.org.au/lanv6n2/update002.html.

Testing food for the presence of lead can be expensive and often it is not easy to discern which foods contain lead. Frequently it is cheaper to test a person's blood lead level and try to work out what other lead sources might be contributing to a blood lead level (>2 mg/dl).

As a preventive measure it is a good idea to test the level of lead in the soil before planting any fruit and vegetables in your backyard or allotment. Whenever there is a product recall, it should be followed. Even if a product is found to contain an amount of lead which is claimed to be not immediately dangerous, food containing lead contributes to your total lead burden. Even small amounts of lead are stored in the bones and can have lifelong effects on health. [13]

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Biosolids used as fertilizer in China and other countries

By Kobe He, Intern, The LEAD Group, Edited by Anne Roberts

The increasing use of bio-solid or human sewage as fertilizer in farms is posing great environmental and health risks. Sewage is well known for its nutrients and cheap price. The use of sewage sludge as fertilizers can be a solution for disposal problems. Nevertheless, heavy metals such as lead are likely to be found in sewage: such materials can be absorbed by plants (the amount absorbed varies among different plants, details of which are found in fact sheet "Is your yard lead safe" by The LEAD Group) and can, in turn, significantly impair functions of human organs.

Raw sewage contains a lot of different nutrients and is likely to be used to irrigate cereal crops and certain vegetables such as spinach. It has been a long time since sewage consisted only of human and animals' faecal material. Since the first industrial revolution took place many undesirable materials have been included in sewage. As a result, nowadays most of the sewage collected from communities must be processed and treated before it is used as a farm fertilizer. The following materials are likely to be found in sewage sludge: water, faecal matter, toilet paper, hair, rancid grease and industrial chemicals (containing heavy metals such as aluminium, copper, zinc, lead, chromium, nickel, molybdenum, selenium, silver, arsenic, mercury etc).

Heavy metal content of the soil after harvest at varying levels of liquid sewage sludge application. (Source: PCARRD, 2002. Highlights 2001, Los Banos, Laguna. From Philippine Organic Agriculture Information Network.)

Heavy Metals	Standard Limit* (ppm)	Level of Metals (ppm) in Soils Applied with Liquid Sewage Sludge (t/ha)			
		0	40	80	120
Arsenic (As)	5.00	0.002	0.002	0.002	0.002

Cadmium (Cd)	5.00	0.001	0.001	0.001	0.001
Chromium (Cr)	5.00	0.067	0.065	0.065	0.079
Lead (Pb)	5.00	0.869	0.845	0.852	0.907
Mercury (Hg)	0.20	0.001	0.001	0.001	0.001
Selenium (Se)	1.00	0.001	0.001	0.002	0.002

For many years it has been unusual for farmers in western countries to use biosolids as fertilizer, as waste treatment is very complicated and expensive. In contrast, farmers in China have used human waste to fertilize fields for more than 4,000 years. After thousands of years of cultivation, China's soil is still fertile and suitable for farming, and soil erosion is not yet common. Given the low price of sewage sludge as a practicable environmental option, movements for the use of sewage sludge have emerged in some developed countries such as the United Kingdom and the United States.

In China, given the rising price of water and chemical fertilizers, up to 10 million farmers are using raw sewage to irrigate and fertilize cropland. Most of the farm operations are highly dependent on local resources, such as drawing water from seriously polluted rivers and lakes and using human sewage as fertilizers.

In parched regions of China, untreated wastewater is the only viable irrigation source keeping farmers in business, as the expense of delivering water from nearby rivers and lakes is prohibitive for farmers who earn less than $2000 a year. In order to reduce the expenditure, they frequently harvest untreated human faeces from latrines and spread it as fertilizer on farms. Even without the direct use of wastewater, there is another serious issue causing lead contamination of soil. The Chinese government does not have well- defined criteria for industrial waste disposal; many factories frequently emit wastewater into rivers and lakes without any processing and treatment, since there is little possibility of being fined and jailed. As a result, many toxins and heavy metals such as lead are released into the rivers and lakes where farmers tend to gather water for irrigation. This results in spreading toxins on their farms, which will remain in the soil for millennia if a clean-up never takes place. Toxins and heavy metals will be absorbed by the crops.

(Editor's note: A study in 2006 found that 33.8% of children in China had a blood lead level greater than 10µg/dL. See: Wang and Zhang)

Biosolids are also widely used in Europe and the US. In parts of Europe and elsewhere biosolids have been applied on agricultural land for more than a century. In the United States biosolid recycling is as old as farm reclamation, even as old as power generation from wind, solar and hydroelectric power sources. But in the US the use of biosolids in agricultural irrigation is regulated at both Federal and State level. Under certain sections of the rules, limits for metal such as lead in biosolids and requirements for biosolids applied to farmland have been maintained and established while also enforcing a risk assessment capability (Biosolid.com, 2002). In recent decades, many countries have actively participated

in conducting field trials to determine the safety and environmental security of biosolid management.

The following accounts are from SourceWatch

In 1993, a team of researchers at the University of Arizona published a research paper that found significant numbers of human disease organisms even in treated sewage sludge.

Sludge pathogens can move through many environmental pathways – direct contact with sludge, evaporation in inhalation, contaminated groundwater, contamination of rodents burrowing in sludge, and uptake through the roots of crops

In Islip, New York, sludge was the cause of the disease that killed 25-year-old Harry Dobin, who ran a coffee truck at a Long Island Railroad station 1000 feet away from a sludge composting site. In July 1991 Dobin began suffering health problems. Doctors treated him unsuccessfully for asthma, arthritis, Lyme disease, kidney disorder and bronchitis. Finally in January 1992 when he could no longer breathe, they performed a lung biopsy and discovered Aspergillus fumigatus, a common byproduct of sludge composting. By the time the disease was correctly diagnosed, it was unstoppable, spreading to his spine, his legs, and finally his heart, leading to his death on September 23, 1992. Other residents of Islip complained of chronic coughing, nausea and other reactions.

Viruses, bacteria, protozoa, fungi and intestinal worms are present in sewage sludge. Many of the pathogens cause diseases that sicken, cripple and kill humans, including salmonella, shigella, campylobacter, E-coli, enteroviruses (which cause paralysis, meningitis, fever, respiratory illness, diarrhoea, encephalitis), giardia, cryptosporidium, roundworm, hookworm, and tapeworm.

Outside Sparta, Missouri, a tiny rural town whose sewage plant began operations in the late 1980s, dairy farmer Ed Rollers began having problems with his cows in 1990. They were falling sick and dying, and no veterinarian or university scientists could tell him why. The death and disease continued until late 1993 when the farm declared bankruptcy.

Scientific soil tests initiated by Rollers revealed that sludge dumped on a field ran onto his fields, which were found to contain lots of heavy metal contaminants. Tests on dead cows were positive for heavy metals, and lead was found in the liver, kidneys, bones and teeth.

In Lynden, Washington, dairy farmers Linda and Raymond Zander began to lose cows one year after sludge was spread on an adjoining farm. "We noticed . . . lameness and other malfunctions," said Linda Zander. Tests found heavy metals in soils at the sludge disposal site and in water from two neighbourhood wells that served several families. Raymond Zander was diagnosed with heavy metal poisoning, and several family members showed signs of neurological damage, which they believe is linked to heavy metal poisoning, including lead. Sixteen neighbouring families have experienced health problems ranging from flu symptoms to cancer.

Sewage sludge is often marketed as "free fertilizer" and welcomed by many farmers. However, problems do not show up overnight. Lead is more likely to produce chronic long term problems rather than an acute attack, except at very high quantities, but the long term accumulation of lead can have as severe an impact on health, for both humans and

animals. Symptoms of this may appear years later. In the case of Zander and Roller, they did not realize what was happening until 2 years later (SourceWatch, 2010).

Legislation of Australia on controlling the amount of lead and other heavy metals that can be added onto agriculture land via sewage sludge

According to the environmental guidelines for the use and disposal of biosolids products published by NSW Environment Protection Authority, a grading system of contaminants has been developed to assist in identifying the suitability of biosolids products for land use or disposal. Each contaminant is to be graded A, B, C, D or E (Grade E being the lowest grade), Contaminant Acceptance Concentration Thresholds for lead (on dry weight basis) are Grade A: 150(mg/kg), Grade B: 150(mg/kg), Grade C: 420(mg/kg), Grade D: 500(mg/kg). The maximum allowable soil lead concentrations for agricultural land following biosolids application is 150 (mg/kg dry weight of soil) (EPA, 2000).

According to the Bureau of Statistics of China's customs department, the total value of exports of agricultural product in China has reached 38 billion US dollars recently.

According to the **Shanghai Agriculture Committee**, the total value of exports of agricultural product in China reached 31 billion US dollars in 2006 , which accounted for 3.9% of total global exports of 788 billion US dollars.

The proportion of exports of agricultural products from China to main import countries from 2002 to 2007 (Shanghai Agriculture Committee, 2009)

Years →	2002	2003	2004	2005	2006	2007
Nations ↓	%	%	%	%	%	%
Japan	31.7	28.5	32.0	29.2	26.5	22.8
Hongkong	11.4	10.4	11.3	9.7	8.6	8.3
Korea	11.3	12.1	9.2	10.5	9.3	9.8
US	9.0	9.7	10.0	10.4	12.2	12.0
Total	66.7	63.7	65.5	63.2	60.1	56.7

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Lead Contamination of Drinking Water in India due to PVC Pipes

By Amar Multani, Mechanical Engineer with training in Environmental Engineering,
Edited by Anne Roberts

Introduction

LEAD CONTENT IN WATER:: CITIES AT RISK			
ALARMING	**HIGH**	**MEDIUM**	**LOW**
Kolkata	Delhi	Chennai	Bangalore
Kochi	Coimbatore	Ludhiana	Ahmedabad
Mumbai	Madurai	Surat	Hyderabad
Pune	Bhubaneshwar	Ghaziabad	Indore
Nagpur		Jamshedpur	Bhopal
Nashik			Chandigarh
Guwahati			Lucknow
			Mangalore
			Mysore

As per various surveys and investigations conducted by organisations such as the 'Quality Council of India,' the presence of 'lead in water' has alarmed people and agencies across the country. Thirty three percent of over 370 samples of water from the top 26 cities of India tested positive for harmful content of lead. Out of these, 31% of samples failed to adhere to the World Health Organization (WHO) standards of a lead content of less than 10 ppb (parts per billion), while 2% of the samples failed to meet even the lenient Indian norms of 50 ppb.

MUNICIPAL WATER WITH HIGH LEVELS OF LEAD	
Kochi	100%
Ludhiana	60%
Bhubaneshwar	50%
Madurai	20%
Chennai	20%
Guwahati	20%

Incidents of high content of lead have been found in ground water (bore well / well water), where as high as 41% samples were unfit for drinking. What is also shocking is that over 15% of Municipal Water had a high content of lead.

Some health effects of Lead poisoning:

- Disruption of the biosynthesis of haemoglobin & anaemia
- A rise in blood pressure, & kidney damage
- Miscarriages and abortions
- Disruption of nervous systems & brain damage
- Reduced fertility due to sperm damage
- Diminished learning abilities in children

Lead Contamination due to PVC pipes is one of the major contributing factors of groundwater pollution in India

Lead poisoning has various long-term negative health effects. It is important to identify the sources of such pollution and to devise methods to eliminate the contributing factors.

In some cases, legislators have to wake up, and make regulations to put controls in place to provide a healthy environment for their citizens.

Sources of lead contamination of potable water supplies & groundwater

- PVC pipes used in sanitation, plumbing & agriculture
- Manufacturing of PVC pipes & products
- Manufacturing of PVC fittings and attachments
- Recycled plastic PVC

PVC pipes used in sanitation, plumbing & agriculture

Domestic: There are two types of manufacturers distributing PVC pipes in India. There are those whose products are ISI endorsed and certified by the government as good quality, and those who produce non-ISI certified goods, with minimal quality control.

ISI endorsed PVC pipes: These manufacturers are involved in manufacturing goods according to quality standards specified by the government of India.

The **Bureau of Indian Standards** (which replaced the Indian Standards Institute (ISI) in 1987), has laid down quality standards for the manufacturing Industry to follow. The products are stamped with the **ISI mark** (or BIS mark), along with the relevant code, e.g. IS 13592, IS 4397, etc. These products are expensive compared to non-ISI marked goods, due to a higher investment in raw materials and laboratory testing.

Non- ISI endorsed PVC pipes**:** The manufacturers follow their own convenient quality standards and are not controlled by the government. The products are not traceable to any quality standard relevant to mitigation of lead poisoning risk or any other potential risk by consumption of polluted water. These PVC pipes are manufactured and sold for domestic, agricultural & industrial consumption.

PVC plumbing pipes are used in India in some apartments constructed by private builders and contractors with zero or minimal awareness of the hazards of lead poisoning.

The ***unorganised sector*** for PVC pipes comprises around 70% of the manufactured goods sold on the basis of *'Local Brand names,'* with manufacturing units spread across the country and owned by small business families. In order to make huge profits, the quality of the pipes is compromised, and additives called stabilisers and plasticisers containing lead are used extensively. These products do not require any special permission from the government to be sold in the market. Potential buyers are unsuspecting middle class, those with less disposable income, and poor farmers without any consumer awareness of the product, and always looking for a cheap bargain.

In Australia, PVC pipe manufacturers belonging to the Plastics Industry Pipe Association of Australia have agreed to phase out the use of lead stablisers in PVC pipe. The phase-out is expected to be achieved by the end of 2010. (Vinyl Council of Australia, 25 Jun 2009.)

The use of lead-based stabiliser by Indian manufacturers is random. The following link provides information about the numerous manufacturers and distributors of lead-based stabilisers:

www.pipa.com.au/docs/FAQPVC.html

These ***Lead-based stabilisers*** may be used properly by committed manufacturers of good quality brands, while restricting the use of lead-based stabiliser or lead-free stabilisers. Such manufacturers comprise only about 20-30% of the entire PVC pipe manufacturing industry in India.

On the other hand, low-quality manufacturers are manufacturing PVC pipes with lead-based stabilisers in unregulated quantities, thus compromising the safety of the product .The government in such cases does not restrict the manufacturers from selling their product in the Indian market. Such products are sold in high volumes due to their low price.

The standard formulation of a PVC pipe is as below

Good Quality PVC Pipe

PVC resin – 85%
Calcium Carbonate -15%
One pack/Stabilisers/Plasticisers without Lead or Cadmium -less than 5%

Poor Quality PVC Pipe

PVC resin -55%
Calcium Carbonate -30%
Lead-based one packs/Stabilisers/Plasticisers eg .TBLS & DBLS–more than 15%
(TBLS-Tribasic Lead stearate & DBLS – Dibasic Lead stearate)

The above facts are stated by one Indian manufacturer 'BALCO' explicitly on their site as per link below:

www.balcogroup.com/products.html

The cost of the *PVC resin* is almost 4 times that of calcium carbonate, hence more calcium carbonate is used in the pipe, and ***lead-based stabilisers or plasticisers*** are added randomly to achieve a stable product which is very cheap compared to a high quality product endorsed by the Indian government 'ISI mark'.

The leaching of lead in such products may be random and high beyond acceptable limits, and usage of the pipes in household construction or agriculture can cause lead poisoning. The amount of lead-based stabilisers in such products will vary depending upon the manufacturer and the purpose or the specifications of the pipe. These pipes have a very long life - up to 75 years - and the amount of lead that will leach, and the period for which it will leach, needs to be investigated. If the lead continues to leach for long periods, this may affect a large population, and two to three generations living in such residential areas.

The leaching of lead in ISI-endorsed products will definitely be less than non–ISI marked products, and can be reduced to zero by banning of lead-based stabilisers and plasticisers in the PVC industry.

Households The use of plumbing PVC pipes of poor quality will cause lead poisoning of the water in the kitchens and bathrooms, and ground water pollution in the area. This lead-poisoned water is used for cooking in large quantities in Indian kitchens, and traces of lead may be found in the entire family. In some cases, such pipes are being used in apartments or multi-storeyed buildings, which may pose a risk to a large number of people. The ***PVC***

plumbing pipes are cheap compared to galvanised iron pipes, and are more durable, with a longer life and zero corrosion. Therefore, these pipes are preferred by the consumer.

PVC Pipes used for sanitation These pipes may be used for drainage applications and can pollute the groundwater with lead and cadmium, due to the presence of lead & cadmium-based plasticisers or stabilisers.

PVC Pipes used for distribution of water in agricultural fields

These cheap PVC pipes are used extensively by Indian farmers, especially in the states of Punjab and Haryana (the food bowl of India), to irrigate the fields with water from tube wells. The lead can find its way in to the groundwater and also into crops.

PVC pipes used for Tube well applications

PVC pipes of large diameter and poor quality are also used by the farmers in fields as outer casing pipes for tube wells. These pipes have a high lead content, and the lead will further pollute ground water as the pipes are permanently in contact with the soil and groundwater.

PVC feeders used in Poultry farming

PVC feeders are also used in poultry farming, to provide the poultry with food and with drinking water. At present there is no standard for measuring lead contamination in Indian poultry products.

Occupational Health & Safety

The manufacturing standards in India prevalent in PVC pipe manufacturing do not take into account the risk of lead poisoning in workers involved in mixing the product in a powder form which can be inhaled. Usually, good brands exhibit 'Corporate Social Responsibility,' and take care of their workers and manage the occupational risks in the facility. However, the majority of manufacturers do not follow adequate safety precautions due to the costs involved. Workers in the unorganised sector are regularly exposed to the use of lead-based chemicals, the handling of which may cause lead poisoning. The facts could be investigated by the government by carrying out blood lead level testing of workers involved in the PVC manufacturing industry.

The Solution

- Banning the use of lead and cadmium-based plasticisers or stabilisers in India is the best solution to eradicate lead pollution
- Removal of PVC pipes with high lead content from buildings and structures which have direct and indirect impact on the intake of drinking water.
- Ensuring only good quality PVC pipes are used in the farming Industry and banning the use of PVC pipes with high lead content.
- Since every child or citizen has the right to a good health & well being, the government should give the highest priority to banning lead-based plasticisers from the PVC Industry.

Fluoride in water: a magical ingredient?

By Monica Maharjan. Edited by Anne Roberts

Due to the amount of landfill produced by plastic drinking water bottles, there are campaigns in industrialized countries to encourage people to drink water from the tap.

However, a recent study by Sawan et al, suggests that tap water containing fluoride may not be wholly beneficial.

[Ref: "Fluoride increases lead concentrations in whole blood and in calcified tissues from lead-exposed rats" by Rosangela MM Sawana, Giselle AS Leite, Maria C.P. Saraiva, Fernando Barbosa Jr., Jose E.Tanus-Santos, Raquel F. Gerlacha. *Toxicology* - Volume 271, Issues 1-2, 30 April 2010, Pages 21-26 http://dx.doi.org/10.1016/j.tox.2010.02.002]

Tap water is a complex solution that may contain lead, copper, chlorine and fluoride, depending how it is stored, treated and transported. Lead and copper can get into water during the transportation process via pipelines; chlorine and fluoride are intentionally added: chlorine for disinfection and fluoride to prevent dental decay.

In many of articles about drinking water, fluoride is described as a 'magical ingredient' for tooth decay prevention. It is believed to be good for our bones and teeth. Fluoridation of water is said to be a safe and cost effective way to reduce dental caries. Many health organizations (both national and international, and including the World Health Organization, WHO) support fluoridation of drinking water; the Centers for Disease Control and Prevention (CDC) even said that it is one of the 10 greatest public health achievements of the 20th century. However, fluoridation of our drinking water has always been debated for its safety and effectiveness.

The study by Sawan et al was on the effect of fluoride on blood lead levels. Even the level of 10ug/dl could cause in cognitive impairment in children. It was found that 'magical' fluoride is actually responsible for an increase in blood lead levels. The study was carried out under controlled condition, using highly purified chemicals (lead, fluoride and complex of fluoride-lead); initially on 28 rats (24 females and 4 males) and later on their offspring. The lead level was measured in dentine, enamel, bone and whole blood samples at the end of the study. It was found that the complex of fluoride-lead significantly increases the lead concentration in blood and calcified tissues. That means fluoride on its own could be a beneficial ingredient but when it complexes with lead could result into higher level of that metal in our bodies.

The amount of chlorine and fluoride in water are regulated by Australian Drinking Water Guidelines, but the amount of lead and copper at the tap cannot be not be known for sure without testing.

The study "showed that co-exposure to fluoride increases lead concentrations in the blood and in calcified tissues in animals exposed to lead from the beginning of gestation. These

findings suggest that a biological effect not recognized so far may underlie the epidemiological association between increased BPb levels in children and water fluoridation."

The aim of this article is to raise awareness of what your drinking water may be doing to you and your children. The LEAD Group's advice is: If your drinking water is fluoridated, consider having the water tested for lead. If the lead levels exceed 0.01mg/L, we advise you to track down the source of the lead: is it coming from lead or galvanized water pipes or lead solder, or leaded bronze or brass in the taps, or is it because of the method of fluoridation used by your water authority?

A Poem: Giving Australia a Hand

By Hugh O'Brien, Lyricist, Speechwriter, Screenwriter & Award-Winning Playwright

It's keeping us between the flags
It's saving towns with sandbags
It's serving in a hospital shop
It's telling tourists where to stop
It's helping the blind play bingo
It's teaching migrants the lingo
It's flagging a goal
It's buttering a roll
It's delivering the meals
It's being the wheels
It's selling red noses
It's arranging church roses
It's serving the homeless soup
It's helping out The LEAD Group

It's good-hearted Aussies pitching in with a grin
It's what they call volunteering
Because the unwritten law of our land
Is giving a neighbour giving a stranger
Giving Australia a hand

It's our bush brigades
Where heroes are made
It's the SES always giving their best
It's Blue Care and Red Cross
It's people who give a toss
It's Aussie Helpers on the farm
It's Lifeline and Salvos and Drug Arm
It's Saint Vinnies and Saint John
The list just goes on and on

PHOTO: Poet Hugh O'Brien "telling tourists where to stop" while holidaying in Egypt,

It's good-hearted Aussies pitching in with a grin
It's what they call volunteering
Because the unwritten law of our land
Is giving a neighbour giving a stranger
Giving Australia a hand

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