Accumulation of Heavy Metals in River Sirumugai and the Affect in Human

P. Ranganayaki, Dr. Y. Thangam, Dr. M. Rabeeth

[1]Chikkanna Arts and Science College, Department of Zoology, Tiruppur

[2]Dt, J.K.K.Nataraja College of Arts and Science,

[3]PG and research department of Zoology Kumarapalayam, Namakkal Dt. Tamilnadu, India

Abstract: ***Water plays an important role in life. With about 70% of the earth's cover being water, it undeniably becomes one of our greatest resources. Water is one of the major resistance in our body. Now a day's water being more polluted due to the abuse of lakes, ponds, oceans, rivers, reservoirs. Pollution of water occurs when a substance that modifies the water in negative fashion and are discharged in it. This discharge of pollutants can be direct as well as indirect. Water pollution is an appalling problem, powerful enough to lead the world on a path of destruction. Water pollutants include both organic and inorganic factors. Organic factors include volatile organic compounds, fuels, waste from trees, plants. Inorganic factors include ammonia, chemical waste from factories, discarded cosmetics. Sirumugai is a river and it is on the bank of river Bhavani. In this river many metals were accumulated, specific metals especially, Cadmium, Chromium, Copper, Iron, Lead, Zinc, and Magnesium, were observed and the accumulation were evaluated.***

Keywords: Sirumugai river, metals- Cd, Cr, Cu, Fe, Pb, Zn, Mg, Accumulation, Bioaccumulation.

1. Introduction

Sirumugai is located at 11.33°N 77.02°E. It has an average elevation of 292 meters (958 feet). It is situated in the northern part of Coimbatore district, on the banks of the Bhavani River. Sirumugai, a village located in Coimbatore district of Tamilnadu, India, has a long legacy that dates back from the period of Tippu Sultan - 18th century ruler of the Kingdom of Mysore. During the period of the British in March 1819, John Sullivan the one Englishmen destined to have the greatest cultural impact on the Queen of Hills' made a bridle path up the hill from Sirumugai to Kotagiri. This was the only transmit to the Nilgris from Coimbatore for a long time. Sirumugai industries, supposedly one of India's largest rayon manufacturing company is located and was functional till the last decade. Now this sketchy village is known for its hand-woven sarees, marketed all over the world with the brand name 'Kora pattu'. Initially from Tipu to Veerappan many prominent men have flourished with the recourses of this mighty little village. Geographically blessed is this land, surrounded by the Western Ghats, and on the banks of the river Bhavani. Sirumugai has some vital places of interest which include the Bhavanisagar Dam. A news report published on 4/9/2005 entitled "A closed chemical factory in Tamil Nadu is waiting to be another Bhopal" mentions that even a gas leak will adversely affect a 4-kilometer radius but a gas explosion would flatten the entire village of Sirumugai. Health Impact; Skin allergies, infertility, advanced maturity in girls, menstrual irregularities, miscarriages, breast & uterine cancer in women and congenital deformities in newborns are some of the health effects (NDT, 2016).

2. Accumulation of metals

1. Cadmium
2. Chromium
3. Copper
4. Iron
5. Lead
6. Zinc
7. Magnesium

Water is life, and indeed its right. With about 70% of the earth's cover being water, it undeniably becomes one of our greatest resources. Water is used in almost every important human chores and processes. It is an important element in both domestic as well as industrial purposes. However closer inspections of our water resources today, give us a rude shock. Infested with waste ranging from floating plastic bags to chemical waste, our water bodies have turned into a pool of poison. The contamination of water bodies in simplest words means water pollution. Thereby the abuse of lakes, ponds, oceans, rivers, reservoirs is water pollution. Pollution of water occurs when a substance that modifies the water in negative fashion are discharged in it. This discharge of pollutants can be direct as well as indirect. Water pollution is an appalling problem, powerful enough to lead the world on a path of destruction. Water is an easy solvent, enabling most pollutants to dissolve in it easily and contaminate it. Water pollutants include both organic and inorganic factors**.** Organic factors include volatile organic compounds, fuels, waste from trees, plants. Inorganic factors include ammonia, chemical waste from factories, discarded cosmetics etc. The water that travels via fields is usually contaminated with all forms of waste inclusive of fertilizers that it swept along the way. This infected water makes its way to our water bodies and sometimes to the seas endangering the flora, fauna and humans that use it along its path. The current scenario has led to a consciousness about water preservation and efforts are being made on several levels to redeem our water resources. Industries and factory set-up's are restricted from contaminating the water bodies and are advised to treat their contaminated waste through filtration methods. People are investing in rain water harvesting projects to collect rainwater and preserve it in wells below ground level. Water Pollution is common, and is an area of high alert. Water needs to be preserved and respected today, for us to live tomorrow (Chris wood, 2016).

Cadmium is an extremely toxic metal commonly found in industrial workplaces. Due to its low permissible exposure limit, over exposures may occur even in situations where trace quantities of cadmium are found. Cadmium is used extensively in electroplating, although the nature of the operation does not generally lead to over exposures. Cadmium is also found in some industrial paints and may represent a hazard when sprayed. Operations involving removal of cadmium paints by scraping or blasting may pose a significant hazard. Cadmium is also present in the manufacturing of some types of batteries. Cadmium levels in the water, air, and soil has been occurring particularly in industrial areas. Environmental exposure to cadmium has been particularly problematic in Japan where many people have consumed rice that was grown in cadmium-contaminated irrigation water. This phenomenon is known under the name itai-itai disease. Food is another source of cadmium. Plants may only contain small or moderate amounts in non-industrial areas, but high levels may be found in the liver and kidneys of adult animals. The daily intake of cadmium through food varies by geographic region. Intake is reported to be approximately 8 to 30μg in Europe and the United States versus 59 to 113 µg in various areas of Japan. Cigarettes are also a significant source of cadmium exposure. Although there is generally less cadmium in tobacco than in food, the lungs absorb cadmium more efficiently than the stomach (Godt, 2006).

Chromium is a chemical element with symbol Cr and atomic number 24. It is the first element in Group 6. It is a steely-grey, lustrous, hard and brittle metal which takes a high polish, resists tarnishing, and has a high melting point. The name of the element is derived from the Greek word χρῶμα, *chrōma*, meaning color, because many of the compounds are intensely colored. Chromium metal is of high value for its high corrosion resistance and hardness. A major development was the discovery that steel could be made highly resistant to corrosion and discoloration by adding metallic chromium to form stainless steel. Stainless steel and chrome plating (electroplating with chromium) together comprise 85% of the commercial use. Hexavalent chromium (Cr(VI)) is toxic and carcinogenic. Abandoned chromium production sites often require environmental cleanup (Costa and Klein, 2006).

Copper can enter the environment through the release of mining of copper and other metals, and from factories that make or use copper metal or copper compounds. Copper can also enter the environment through waste dumps, domestic waste water, combustion of fossil fuels and wastes, wood production, phosphate fertilizer production, and natural sources (for example, windblown dust, from native soils, volcanoes, decaying vegetation, forest fires, and sea spray). Therefore, copper is widespread in the environment. About 1,400,000,000 pounds (640,000,000,000 grams) of copper were released into the environment by industries in 2000. Copper is often found near mines, smelters, industrial settings, landfills, and waste disposal sites (Carol Potera, 2004).

Iron is an essential trace element in living organisms. The data in this section are derived from studies in humans only; laboratory animals are not acceptable models because they have much higher intakes than humans and do not absorb iron compounds in the same way. Most iron is absorbed in the duodenum and upper jejunum. Absorption depends on the individual's iron status and is regulated so that excessive amounts of iron are not stored in the body. Total body iron in adult males and females is usually about 50 and 34–42 mg/kg of body weight, respectively. The largest fraction is present as haemoglobin, myoglobin, and haem-containing enzymes. The other major fraction is stored in the body as ferritin and haemosiderin, mainly in the spleen, liver, bone marrow, and striate muscle. Daily losses of iron in adults are small (1 mg/day) and due mainly to cell exfoliation. About two-thirds of this loss occurs from the gastrointestinal tract and most of the remainder from the skin. Iron losses in urine and sweat are negligible. In adult females, there is an additional iron loss of about 15–70 mg each month in menstrual blood. (Abbaspour, 2014).

Lead is a toxic metal that is harmful to human health and there is no safe level for lead exposure. The degree of exposure depends on the concentration of lead, route of exposure (air, water, food), current medical condition, and age. It has been estimated that up to 20 % of the total lead exposure in children can be attributed to a waterborne route, i.e., consuming contaminated water. In addition, infants, fetuses, and young children are particularly vulnerable to lead poisoning. This is because they usually consume more water and their bodies are actively developing, which facilitates the bioaccumulation of lead. High levels of lead contamination in a child can result in convulsions, major neurological damage, organ failure, coma, and ultimately death. Moderate to low levels of exposure may result in hearing loss, inhibit growth, and cause learning disabilities. There may be no signs of lead poisoning or the signs could mimic flu or other gastrointestinal disease. The symptoms may include: cramps, irritability, fatigue, vomiting, constipation, sleep disorder, poor appetite, and trouble sleeping. Unlike other contaminants, lead will accumulate within the body over time, i.e., bioaccumulate. Lead will tend to be stored in the brain, bones, kidneys and other major organs. It can be stored in child's blood for months and bones for many decades. Some of the effects of lead poisoning cannot be cured, but it is possible to reduce exposure to lead (NIH, 2016)

Zinc was not attributed a water hazard class, because it is not considered a hazard. This however only concerns elementary zinc. Some zinc compounds, such as zinc arsenate and zinc cyanide, may be extremely hazardous. Zinc is a dietary mineral for humans and animals. Still, overdoses may negatively influence human and animal health and over a certain boundary concentration, zinc may even be toxic. Toxicity is low for humans and animals, but phytotoxicity may not be underestimated. Sludge from wastewater treatment is applied in agriculture, horticulture and forestry, and zinc concentrations may therefore not exceed the 3g/ kgboundary. Ecotoxicological tests attributed a 50 µg/L PNEC value to dissolved zinc. This means total concentrations of 150-200 µg/L of zinc in water. This PNEC value represents the maximum concentration where no environmental effect occurs. Industrial zinc emissions decreased strongly in the past decades. Current zinc values are not a very extensive environmental risk. Zinc concentrations in the River Rhine have reached optimal values. Unfortunately, locations of historical contamination still exist. A total of five stable zinc isotopes occur naturally, among which are ^{64}Zn, ^{66}Zn and ^{68}Zn. ^{65}Zn is present in nuclear reactor cooling water, and is applied in medicine. Zinc appears to accumulate in some organisms (WHO, 2017).

Of all the cardiovascular risk factors, magnesium now takes first place as judged by the accumulation of epidemiological, pathophysiological, clinical and experimental data, both pharmacological and therapeutic. The "water story" began in 1957 when, after observing a geographical correlation between stroke-associated mortality and river water acidity Kobayashi inferred a possible relationship between the composition of drinking water and cardiovascular diseases. Schroeder checked the validity of the Japanese data statistically and then examined the implications of the phenomenon in the USA. He suggested an inverse relationship between various types of heart diseases and drinking water hardness: drinking soft water increases cardiovascular risk and this effect is reciprocally reduced by hard water consumption. Numerous studies in all the continents have been devoted to this negative correlation with hardness, involving many statistical units of observation (states, districts, towns), diversification of causes of mortality (general, cardiac, vascular) and multiplications of observed variables (climatic and geographical factors, analytical data on water). This inverse relationship has been confirmed in the majority of the studies and in particular in those done on the largest geographical scale. However, the variable relating to water hardness cannot be considered a constant risk since in some studies its effect may be completely absent, the statistical significance of the other ecological variables involved in the water story should not be underestimated, and other confounding aetiological and atmospheric co-factors (ie amount of rainfall, salt-consumption) which are associated with hardness may play a role. However the most important aim must be to define clearly the factors in drinking water which may be involved in maintaining the cardiovascular apparatus in satisfactory condition. It is therefore necessary to have an accurate definition of hardness. Hardness is defined by hydrotimetry, ie a measurement which determines the presence of encrusting properties which antagonize vegetable cooking and soap lathering. The bulk of total_hardness is made up by Ca and Mg compounds but in some areas salts of other metals are also present in significant amounts (Del Gobbo, 2013). The aim of this research is to study about the accumulation of heavy metals in the Sirumugai River.

3. Methods

For water sampling, polyethylene bottles were acid-washed with 10% concentrated nitric acid HNO3 (v/v) and rinsed thoroughly with distilled deionized water. All glassware and equipment used were acid–washed. The bottles were rinsed three times and immersed about 10 cm below the water surface before sampling. Three 500 ml of water samples were taken at each sampling point, and kept in ice while been transported to laboratory. The samples were filtered through 0.45 µm micropore membrane filter and acidified with concentrated HNO3 (65%) to a pH less than 2. The samples were kept at 4°C before treatment. Sample preparation for water: About 9ml of concentrated HNO3 were added to filtered water sample and heated gently at 70°C until the solution become transparent. The solutions were allowed to cool and filtered using 0.45µm micropore membrane filter. The solutions were then added up with ultra-pure of water to 100ml and analyzed for trace metal concentration. Reagents: All reagents were of analytical reagent grade. Ultra-pure water was used for all dilutions. The element standard solutions from Perkin Elmer that were used for the calibrations were prepared by diluting stock solutions of mg/mL.

Heavy metal analysis: All samples were digested in concentrated HNO3 and H2O2 in a beaker. The samples were then diluted until 50 ml with ultra-pure water. After filtration, the prepared samples were determined for Cd, Cr, Cu, Fe, Pb, Zn, Mg, by using atomic absorption spectrophotometer (AAS). Heavy metals included in this study are: Cd (Cadmium), Cr (Chromium), Cu (Copper), Fe (Iron), Pb (Lead), Zn (Zinc), Mg (Magnesium), Element standard solution from Perkin Elmer was prepared by diluting stock solutions of 100mg/mL.

4. Result

The accumulation of heavy metals Cadmium, Chromuim, Copper, Iron, Lead ,Zinc and magnesium in water were observed and the values were evaluated. The metal Lead is accumulated in water highly about 3.8% the next metal is zinc 3.0%, Magnesium is 2.7%. Chromium 1.6%, Copper 1.2% and Cadmium is 1.1% was observed in river Sirumugai.

Table 1: Sirunmugai River

S.No	*Metals*	*Accumulation in water*
1	Cd	1.1
2	Cr	1.6
3	Cu	1.2
4	Fe	1.0
5	Pb	3.8
6	Zn	3.0
7	Mg	2.7

5. Discussion

Pollution of one form or another, in the food we eat, the water we drink and the air we breathe. Very often the actions lead to pollution. The notes below explains how to investigate pollution and advise on positive action to improve the rivers.

- Polluting the Rivers
- Investigating River Pollution
- Signs of Pollution
- Credits
- Polluting the Rivers

Over 97% of all the water on Earth is salty and most of the remaining 3% is frozen in the polar ice-caps. The atmosphere, rivers, lakes and underground stores hold less than 1% of all the fresh water and this tiny amount has to provide the fresh water needed to support the Earth's population. Fresh water is a precious resource and the increasing pollution of our rivers and lakes is a cause for alarm. Water sources (groundwater, lakes, streams and rivers) can be polluted by heavy metals leaching from industrial and consumer waste; acid rain can exacerbate this process by releasing heavy metals trapped in soils. Plants are exposed to heavy metals through the uptake of water; animals eat these plants; ingestion of plant- and animal-based foods is the largest sources of heavy metals in humans. Absorption through skin contact, for example from contact with soil, is another potential source of heavy metal contamination. Toxic heavy metals can bioaccumulate in organisms as they are hard to metabolize. (Zoe SCHLANGER, 2016).

6. Causes of Water Pollution

1. Industrial waste: Industries produce huge amount of waste which contains toxic chemicals and pollutants which can cause air pollution and damage to us and our environment. They contain pollutants such as lead, mercury, sulphur, asbestos, nitrates and many other harmful chemicals. Many industries do not have proper waste management system and drain the waste in the fresh water which goes into rivers, canals and later in to sea. The toxic chemicals have the capability to change the color of water, increase the amount of minerals, also known as Eutrophication, change the temperature of water and pose serious hazard to water organisms.

2. Sewage and waste water: The sewage and waste water that is produced by each household is chemically treated and released in to sea with fresh water. The sewage water carries harmful bacteria and chemicals that can cause serious health problems. Pathogens are known as a common water pollutant; The sewers of cities house several pathogens and thereby diseases. Microorganisms in water are known to be causes of some very deadly diseases and become the breeding grounds for other creatures that act like carriers. These carriers inflict these diseases via various forms of contact onto an individual. A very common example of this process would be Malaria.

3. Mining activities: Mining is the process of crushing the rock and extracting coal and other minerals from underground. These elements when extracted in the raw form contain harmful chemicals and can increase the amount of toxic elements when mixed up with water which may result in health problems. Mining activities emit several metal waste and sulphides from the rocks and is harmful for the water.

4. Marine dumping: The garbage produce by each household in the form of paper, aluminum, rubber, glass, plastic, food if collected and deposited into the sea in some countries. These items take from 2 weeks to 200 years to decompose. When such items enter the sea, they not only cause water pollution but also harm animals in the sea.

5. Accidental Oil leakage: Oil spill pose a huge concern as large amount of oil enters into the sea and does not dissolve with water; there by opens problem for local marine wildlife such as fish, birds and sea otters. For e.g.: a ship carrying large quantity of oil may spill oil if met with an accident and can cause varying damage to species in the ocean depending on the quantity of oil spill, size of ocean, toxicity of pollutant.

6. Burning of fossil fuels: Fossil fuels like coal and oil when burnt produce substantial amount of ash in the atmosphere. The particles which contain toxic chemicals when mixed with water vapor result in acid rain. Also, carbon dioxide is released from burning of fossil fuels which result in global warming.

7. Chemical fertilizers and pesticides: Chemical fertilizers and pesticides are used by farmers to protect crops from insects and bacterias. They are useful for the plants growth. However, when these chemicals are mixed up with water produce harmful for plants and animals. Also, when it rains, the chemicals mixes up with rainwater and flow down into rivers and canals which pose serious damages for aquatic animals.

8. Leakage from sewer lines: A small leakage from the sewer lines can contaminate the underground water and make it unfit for the people to drink. Also, when not repaired on time, the leaking water can come on to the surface and become a breeding ground for insects and mosquitoes.

9. Global warming: An increase in earth's temperature due to greenhouse effect results in global warming. It increases the water temperature and result in death of aquatic animals and marine species which later results in water pollution.

10. Radioactive waste: Nuclear energy is produced using nuclear fission or fusion. The element that is used in production of nuclear energy is Uranium which is highly toxic chemical. The nuclear waste that is produced by radioactive material needs to be disposed off to prevent any nuclear accident. Nuclear waste can have serious environmental hazards if not disposed off properly. Few major accidents have already taken place in Russia and Japan.

11. Urban development: As population has grown, so has the demand for housing, food and cloth. As more cities and towns are developed, they have resulted in increase use of fertilizers to produce more food, soil erosion due to deforestation, increase in construction activities, inadequate sewer collection and treatment, landfills as more garbage is produced, increase in chemicals from industries to produce more materials.

12. Leakage from the landfills: Landfills are nothing but huge pile of garbage that produces awful smell and can be seen across the city. When it rains, the landfills may leak and the leaking landfills can pollute the underground water with large variety of contaminants.

13. Animal waste: The waste produce by animals is washed away into the rivers when it rains. It gets mixed up with other harmful chemicals and causes various water borne diseases like cholera, diarrhea, jaundice, dysentery and typhoid.

14. Underground storage leakage: Transportation of coal and other petroleum products through underground pipes is well known. Accidentals leakage may happen anytime and may cause damage to environment and result in soil erosion.

Heavy metals "can bind to vital cellular components, such as structural proteins, enzymes, and nucleic acids, and interfere with their functioning." Symptoms and effects can vary according to the metal or metal compound, and the dose involved. Broadly, long-term exposure to toxic heavy metals can have carcinogenic, central and peripheral nervous system and circulatory effects. For humans, typical presentations associated with exposure to any of the "classical" toxic heavy metals, or chromium (another toxic heavy metal) or arsenic (a metalloid), are shown in the table (Chris wood, 2016). Cadmium (Cd) is an extremely toxic industrial and environmental pollutant classified as a human carcinogen [Group 1 – according to International Agency for Research on Cancer Group 2a – according to Environmental Protection Agency (EPA); and 1B carcinogen classified by European Chemical Agency. Acute exposure to cadmium fumes may cause flu-like symptoms including chills, fever, and muscle ache sometimes referred to as "the cadmium blues." Symptoms may resolve after a week if there is no respiratory damage. More severe exposures can cause tracheo-bronchitis, pneumonitis, and pulmonary edema. Symptoms of inflammation may start hours after the exposure and include cough, dryness and irritation of the nose and throat, headache, dizziness, weakness, fever, chills, and chest pain (EPA, 2015).

Chromium does not occur freely in nature. The main chromium mineral is chromite. As was mentioned earlier, chromium compounds can be found in waters only in trace amounts. The element and its compounds can be discharged in surface water through various industries. It is applied for example for metal surface refinery and in alloys. Stainless steel consists of 12-15% chromium. Chromium metal is applied worldwide in amounts of approximately 20,000 tons per year.
Chromium is a dietary requirement for a number of organisms. This however only applies to trivalent chromium. Hexavalent chromium is very toxic to flora and fauna. Chromium water pollution is not regarded one of the main and most severe environmental problems, although discharging chromium polluted untreated wastewater in rivers has caused environmental disasters in the past.

Chromium (III) oxides are only slightly water soluble; therefore concentrations in natural waters are limited. Cr^{3+} ions are rarely present at pH values over 5, because hydrated chromium oxide ($Cr(OH)_3$) is hardly water soluble. Chromium (VI) compounds are stable under aerobic conditions, but are reduced to chromium (III) compounds under anaerobic conditions. The reverse process is another possibility in an oxidizing environment. Chromium is largely bound to floating particles in water. The human body contains approximately 0.03 ppm of chromium. Daily intake strongly depends upon feed levels, and is usually approximately 15-200 μg, but may be as high as 1 mg. Chromium uptake is 0.5-1%, in other words very small. The placenta is the organ with the highest chromium amounts (Stern, 2016).

The concentration of copper in lakes and rivers ranges from 0.5 to 1,000 ppb with an average concentration of 10 ppb. The average copper concentration in groundwater (5 ppb) is similar to that in lakes and rivers; however, monitoring data indicate that some groundwater contains levels of copper (up to 2,783 ppb) that are well above the standard of 1,300 ppb for drinking water. This copper is generally bound to particles in the water. Lakes and reservoirs recently treated with copper compounds to control algae or receive cooling water from a power plant can have high concentrations of dissolved copper. Once in natural water, much of this copper soon attaches to particles or convert to other forms that can settle into sediments. This can limit exposure to copper unless the sediments are stirred; for example, by the resuspension and swallowing of sediments by swimmers in recreational waters (Wapnir,. 1998).

The median iron concentration in rivers has been reported to be 0.7 mg/litre. In anaerobic groundwater where iron is in the form of iron(II), concentrations will usually be 0.5–10 mg/litre, but concentrations up to 50 mg/litre can sometimes be found (6). Concentrations of iron in drinking-water are normally less than 0.3 mg/litre but may be higher in countries where various iron salts are used as coagulating agents in water-treatment plants and where cast iron, steel, and galvanized iron pipes are used for water distribution. Anaerobic groundwater's may contain iron(II) at concentrations up to several milligrams per litre without discoloration or turbidity in the water when directly pumped from a well. Taste is not usually noticeable at iron concentrations below 0.3 mg/litre, although turbidity and colour may develop in piped systems at levels above 0.05–0.1 mg/litre. Laundry and sanitary ware will stain at iron concentrations above 0.3 mg/litre. Iron is an essential element in human nutrition. Estimates of the minimum daily requirement for iron depend on age, sex, physiological status, and iron bioavailability and range from about 10 to 50 mg/day. 4 As a precaution against storage.

The Lead Source- One Source Drinking Water: Drinking water is only one of the possible routes of exposure to lead contamination, but it is one of the easiest routes of contamination to reduce. The primary route for lead poisoning in drinking water is not old contamination of the water by leaded fuels, old batteries or some hazardous waste site, the primary route is the distribution system used to carry water to your home and more importantly the plumbing within your home. That is right: Household plumbing may be the cause for lead in your drinking water. In older homes, lead was used to make the piping and/or solder. In homes, built prior to 1930's water pipes were primarily made from lead. These pipes can be identified because the piping tends to have a dull gray color, can be scratched with a key, and a magnet will not stick to the piping. In buildings built between the 1930's and early 1980's, copper pipes were often used, but the solder contained elevated levels of lead. This does not mean that a newer home is safe from lead contamination; in fact, the available data suggests that buildings less than 5 years old can have high levels of lead. In fact, buildings built prior to 1986 likely contain some lead plumbing.

Prior to 2014, the legal definition for "lead free" was plumbing fixtures with a lead content of less than 8 %. In 2014, the term was redefined to include only fixtures with a lead content of 0.25% and newly installed fixtures must use the "lead free" materials, but this did not apply to fixtures currently in use. In 2013, the World Health Organization estimated that lead poisoning resulted in 143,000 deaths, and "contribute[d] to 600,000 new cases of children with intellectual disabilities", each year. In the U.S. city of Flint, Michigan, lead contamination in drinking water has been an issue since 2014. The source of the contamination has been attributed to "corrosion in the lead and iron pipes that distribute water to city residents". In 2015, drinking water lead levels in north-eastern Tasmania, Australia, were reported to reach over 50 time's national drinking water guidelines. The source of the contamination was attributed to "a combination of dilapidated drinking water infrastructure, including lead jointed pipelines, end-of-life polyvinylchloride pipes and household plumbing (EPA, 2016). Zinc is naturally present in water. The average zinc concentration in water is 0.6-5ppb. Rivers generally contain between 5 and 10 ppb zinc. Algae contain 20-700 ppm,sea fish and shells contain 3-25 ppm, oysters contain 100-900 ppm and lobstercontain7-50 ppm. The World Health Organization stated a legal limit of 5 mg Zn^{2+}/L.

The human body contains approximately 2.3 g zinc, and zinc has a dietary value as a trace element. Its functions involve mainly enzymatic processes and DNA replication. The human hormone insulin contains zinc, and it plays an important role in sexual development. Minimum daily intake is 2-3 g, this prevents deficiencies. The human body only absorbs 20-40% of zinc present in food; consequently many people drink mineral water rich in zinc. Symptoms of zinc deficiencies are tastelessness and loss of appetite. Children's immune systems and enzyme systems may be affected. Higher zinc application appears to protect people from cadmium poisoning. Zinc may also decrease lead absorption. The relation copper : zinc in the human body is an important characteristic.

One may also absorb zinc overdoses. This does not occur very regularly. Symptoms include nausea, vomiting, dizziness, colics, fevers and diarrhoea and mostly occur after intake of 4-8 g of zinc. Intakes of 2 g of zinc sulphate at once cause acute toxicity leading to stomach aches and vomiting.

Strikingly, zinc belongs to the same elemental group in the periodic chart as cadmium and mercury, which are both toxic. Examples of zinc-related health effects also include mucous membrane infection from zinc chloride (lethal dose 3-5 g), and zinc vitriol poisoning (lethal dose 5 g) (Nordqvist, 2016).

"Absolute" and "relative" magnesium deficit (MD) induces increased secretion of several neurohormones which are pathogenic for the cardiovascular system, ie adrenaline, insulin and PTH, and it also induces a decrease in secretion of CT, a hormone with protective properties for the cardiovascular system. In addition, MD induces other neurohormonal or metabolic disturbances which may have deleterious consequences, for example increased production of renin and aldosterone, calcinosis, dyslipidaemias and alterations in haemostasis. An adequate intake of water Mg may in particular palliate "absolute" marginal MD with a critical supply over the marginal intake, and/or qualitatively palliate a "relative" MD by supplying Mg of high bio-availability. Among the numerous variables involved in the "water story" Mg appears preeminant. Its importance is both quantitative and qualitative. The critical quantitative intake of water Mg may palliate an "absolute" Mg deficit and its multiple consequences particularly on the nephrocardiovascular apparatus. Even in the case of a balanced daily Mg intake, water Mg may qualitatively act on the nephrocardiovascular apparatus by palliating a genuine "qualitative" Mg deficit due to a deficient amount of highly bioavailable Mg. It reduces the activation of the neuroendocrine regulatory mechanisms of Mg homeostasis which also control the metabolisms of water, Cl, Na, K, P and Ca and the regulation of vasomotortone. Corrosivity is the other main factor of the "water story". Mg appears as a competitive inhibitor of the two main noxious polluting agents: Pb and Cd. It is advisable to have 30 mg/litre of Mg in drinking water. If the water is not corrosive, it is not advisable to enrich it with Mg in the course of the processing since its corrosivity index would also increase. A Mg salt can only be added after the water has been collected. If the water is corrosive, it will be filtered in processing stations through an anticorrosive filter with optimum Mg/Ca ratio to ensure the highest Mg/Ca ratio in tap water with the best anticorrosive power (Witkowski, 2011).In this research we come to know that the accumulation of different metals in water and their effect. Increase in metal causes many diseases and decrease in metals causes many side affects in human body.

References

[1] NDT. Human chain formed against Kerala's plan to build dam on River Siruvani".2012. Chris Woodford. Water pollution An introduction, *Environ Sci* 5: 365-369. 2016.
[2] GodtJ, ChristianF, SiestrupG, EscheV, BrandenburgP, ReichA, GronebergDA. The toxicity of cadmium and resulting hazards for human health. *J Occup Med Toxicol*. 1: 22. 2006.
[3] CostaM & KleinCB. Toxicity and Carcinogenicity of Chromium Compounds in Humans. *Critical Reviews in Toxicology*, 36(2), 155-163. 2006
[4] Carol Potera. Copper in Drinking Water: Using Symptoms of Exposure to Define Safety. *Environ Health Perspect*. 112(10): A568–A569. 2004.
[5] AbbaspourN, HurrellR, KelishadiR. Review on iron and its importance for human health. J Res Med Sci. 19(2): 164–174. 2014.
[6] NIH ,National Institutes of Health U.S. Department of Health and Human Services.Review on lead. 2016.
[7] WHO. World Health Organization.Centers for Disease Control and Prevention technical consultation on the assessment of iron status at the population level; p. 108. 2017.

[8] DelGobboLC, ImamuraF, WuJHY, OttoMCdO, ChiuveSE, MozaffarianD. Circulating and dietary magnesium and risk of cardiovascular disease: a systematic review and meta-analysis of prospective studies. *Am J Clin Nutr*. 98:160-73. 2013.

[9] ZoeS. Lead-tainted water in Flint, Michigan to the plume of methane still spewing into LA's air supply. *Tech & Science*. 2016.

[10] EPA, Environmental protection agency. Review of cadmium and its effect. 2015.

[11] SternAH. A quantitative assessment of the carcinogenicity of hexavalent chromium by the oral route and its relevance to human exposure. *Environmental Research.* 110(8), 798-807. 2010.

[12] WapnirRA. Copper absorption and bioavailability. Am. J. Clin. Nutr. 67: 5 1054-1060.1998.

[13] EPA. Environmental protection agency. Review of lead and source of drinking water. 2016.

[14] NordqvistJ, Zinc: Health Benefits, Facts, *Nutrition DietComplementary Medicine Alternative Medicine*. 2016.

[15] WitkowskiM, HubertJ, MazurA. Methods of assessment of magnesium status in humans: a systematic review. *Magnesium Res* .24:163-80. 201.