Original Article

Toxic Effects of Heavy Metals in Water

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Abstract

Several severe diseases have been influenced by the poisonous effects of heavy metals in water. Samples from a freshwater source and a water source running through an industrial town are taken to assess the rising quantities of these heavy metals. To determine if the concentration has increased over time, data from the same water source is compared to data collected in 2009. The industrial workers were also surveyed via questionnaire to learn how this water is affecting them. Simple preventive measuresare included along with a variety of cutting-edge techniques to eliminate hazardous metals from water.

Keywords: Electrodialysis; Flocculation; Ion exchange; Microbial Fuel Cell (MFC); Photocatalysis; Phytoremediation

Introduction

Water is becoming an increasingly sparse resource. As man moves up in his level of industrialization, the effluents given out also increase. The quality of water is a primary environmental concernfor health reasons and also for crop productivity. Water dissolves all soluble matter with which it comes in contact. Groundwater, therefore, contains a higher mineral content than surface water due to very slow percolation and a longer period of contact. In the case of groundwater, the quality varies from stratum to stratum aswell as at different depths due to changes in chemical composition. Lakes and reservoirs are vital parts of the freshwater ecosystems of any country. The intensive agricultural practices and land use changes due to residential development in the catchment have reduced the inflow into the impoundments. All over the country without exception, the lakes and reservoirs are in varying degrees of environmental degradation. One of the main reasons for this is the increasing amount of heavy metals in water. The Toxic effects of heavy metals in water isa problem similar to global warming, if not addressed soon can gradually become a major concern. Heavy metals haverelatively high density compared to water hence heavy metals are potentially hazardous in combined or elemental form. Heavy metals within allowable limits in themselves are generally associated with low health risks in humans. The government has rules and regulations in place to prohibit people from living near places where water toxicity is high but enforcing these regulations is difficult particularly in densely populated regions, as there may be a shortage of affordable housing. Effective prevention or minimizing of further dissolution of heavy metals in water and treating the existing toxic effects of these heavy metalsis a challenge that can be corrected by the contribution of the people even in the most minute way possible.

Methods

To gain insight into this subject, we collected water samples from different places and compared them with report of purified water. We also

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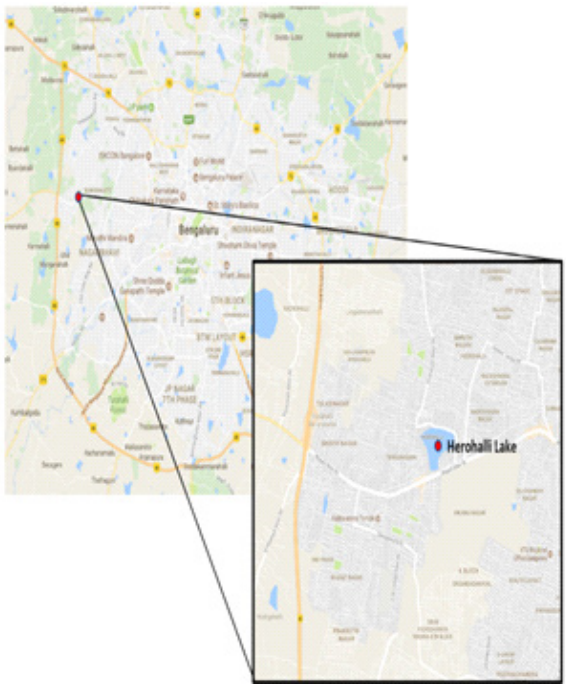
conducted surveys of industrial workers by handing out questionnaires. This helped us get to know how the water flowing near industries is affecting workers. The first sample was from the industrial town of Kamakshipalya. The 'vrishabavathi' river flows across this industrial region. It was originally a river so pure that residents who lived nearby used it for drinking and many other purposes but industrialization caused the concentration of heavy metals to rise, making the water exceedingly hazardous. The other sample was collected from the fresh water lake of Herohalli. Historically, these reservoirs of this lake were primarily either irrigation tanks or used for the water supply, with secondary uses such as bathing and washing. The water samples collected were sent for testing to a Lab in Bengaluru. The test was done based on the physicochemical characteristics of water. These results mainly indicate the concentration of organic and inorganic constituents and interpretations in relation to the geological sources, pollution sources, climate, etc.

Vrishabhavathi river

Herohalli Lake:



Report 1: Sample collected from the HerohalliLake:

INDIAN ANALYTICAL TESTING LABORATORY

An ISO 9001:2015 Certified Laboratory

No.3, 3rd Floor, A Main Road, North Layout, Nayandanahalli, Near Indian Oil Petrol Bunk, Bangalore: 560039, Karnataka.

Mob No: 8553345681/7899440170 E-Mail: iatlaboratory@gmail.com Web site: www.iatlab.com

TEST CERTIFICATE

Certificate No.: IATL022/01/SCW/069	**Certificate Date:** 31/01/2023
Issued To: **STUDENTS NAME:** **1.H R ANEESH TEJAS** **2.HITESH S P** **3.ARYAN JHA** **4.AAKANKSH N** **5.EISA JAMEEL** **Faculty advisor : Dr. Manjunatha C**	**Date of Sample Receipt:**25/01/2023 **Sample Code.:** IATL022/01/SCW/069 **Sample Collected By:** 1.H R ANEESH TEJAS 2.HITESH S P 3.ARYAN JHA 4.AAKANKSH N 5.EISA JAMEEL
Description of Sample: Lake Water	

Sl. No.	Parameters	Test Method (Reference)	Limits as per IS 10500:2012 ((in mg/L)	Results
01	Color, Hazen Units	IS 3025 (Part 4)	2 Unit	1.80
02	Odor	IS 3025 (Part 5)	Agreeable	Agreeable
03	Taste	IS 3025 (Part 8)	Agreeable	Agreeable
04	Turbidity, NTU	IS 3025 (Part 10)	1.0 NTU	<1.0
05	pH @ 25^0 C	IS 3025 (Part 11)	6.5 to 8.5	7.69
06	Total Dissolved Solids, mg/L	IS 3025 (Part 16)	500.0	546.0
07	Total Hardness as $CaCO_3$, mg/L	IS 3025 (Part 21)	200.0	202.0
08	Alkalinity as $CaCO_3$, mg/L	IS 3025 (Part 23)	200.0	94.0
09	Sulphate as SO4, mg/L	IS 3025 (Part 24)	200.0	140.5
10	Calcium as Ca, mg/L	IS 3025 (Part 40)	75.0	36.90
11	Chloride as Cl, mg/L	IS 3025 (Part 32)	250.0	99.0
12	Copper as Cu, mg/L	IS 3025 (Part 42)	0.05	0.04
13	Iron as Fe, mg/L	IS 3025 (Part 53)	0.10	0.09
14	Magnesium as Mg, mg/L	IS 3025 (Part 46)	30.0	21.24
15	Residual Free Chlorine, mg/L	IS 3025 (Part 26)	0.2	BDL
16	Nitrate as NO_3, mg/L	IS 3025 (Part 34)	45.0	38.4
17	Dissolved Oxygen, mg/L	IS 3025 (Part 38)	--	10.20
18	Chemical Oxygen Demand, mg/L	IS 3025 (Part 58)	50.0	46.20
19	BOD for 5 days @25^{0}C, mg/L	IS 3025 (Part 44)	10.0	9.90
20	Fluoride as F, mg/L	IS 3025 /Part 60	1.0	0.90
21	Total Suspended Solids, mg/L	IS 3025 /Part 17	20.0	23.40
22	Fecal Coliform, MPN/100 ml	IS:1622-1993	100cfu/100ml	118cfu

BDL-Below Detection Limit,

*****End of the Report****

Analysed by:

Authorised Signatory

Note: 1. The results listed pertain only to the tested samples and applicable parameters.
2. Sample will be destroyed after 15 days from the date of issue of test certificate unless & otherwise specified.
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4. Sampling not done by us, unless specified.

Report 2: Sample collected from the Vrishabhavathi river

INDIAN ANALYTICAL TESTING LABORATORY

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Mob No: 8553345681/7899440170 E-Mail: iatlaboratory@gmail.com Web site: www.iatlab.com

TEST CERTIFICATE

Certificate No.: IATL023/03/SCW/024	**Certificate Date:** 21/03/2023
Issued To: **STUDENTS NAME:** **1.H R ANEESH TEJAS** **2.HITESH S P** **3.ARYAN JHA** **4.AAKANKSH N** **5.EISA JAMEEL** **Faculty advisor : Dr. Manjunatha C**	**Date of Sample Receipt:** 18/03/2023 **Sample Code.:** IATL023/03/SCW/024 **Sample Collected By:** 1.H R ANEESH TEJAS 2.HITESH S P 3.ARYAN JHA 4.AAKANKSH N 5.EISA JAMEEL

Description of Sample: Vrushabhavathi River Water

Sl. No.	Parameters	Test Method (Reference)	Limits as per IS 10500:2012 ((in mg/L)	Results
01	Color, Hazen Units	IS 3025 (Part 4)	2 Unit	1.40
02	Odor	IS 3025 (Part 5)	Agreeable	Agreeable
03	Taste	IS 3025 (Part 8)	Agreeable	Not Agreeable
04	Turbidity, NTU	IS 3025 (Part 10)	1.0 NTU	<1.0
05	pH @ 25° C	IS 3025 (Part 11)	6.5 to 8.5	7.96
06	Total Dissolved Solids, mg/L	IS 3025 (Part 16)	500.0	680.0
07	Total Hardness as $CaCO_3$, mg/L	IS 3025 (Part 21)	200.0	216.0
08	Alkalinity as $CaCO_3$, mg/L	IS 3025 (Part 23)	200.0	138.0
09	Sulphate as SO4, mg/L	IS 3025 (Part 24)	200.0	126.3
10	Calcium as Ca, mg/L	IS 3025 (Part 40)	75.0	41.20
11	Chloride as Cl, mg/L	IS 3025 (Part 32)	250.0	110.0
12	Copper as Cu, mg/L	IS 3025 (Part 42)	0.05	0.05
13	Iron as Fe, mg/L	IS 3025 (Part 53)	0.10	0.11
14	Magnesium as Mg, mg/L	IS 3025 (Part 46)	30.0	27.34
15	Residual Free Chlorine, mg/L	IS 3025 (Part 26)	0.2	BDL
16	Nitrate as NO_3, mg/L	IS 3025 (Part 34)	45.0	32.6
17	Dissolved Oxygen, mg/L	IS 3025 (Part 38)	--	14.60
18	Chemical Oxygen Demand, mg/L	IS 3025 (Part 58)	50.0	38.40
19	BOD for 5 days @25°C, mg/L	IS 3025 (Part 44)	10.0	6.80
20	Fluoride as F, mg/L	IS 3025 /Part 60	1.0	0.60
21	Total Suspended Solids, mg/L	IS 3025 /Part 17	20.0	19.80
22	Fecal Coliform, MPN/100 ml	IS:1622-1993	100cfu/100ml	86cfu

BDL-Below Detection Limit,

******End of the Report******

Analysed by:

Authorised Signatory:

Note: 1. The results listed pertain only to the tested samples and applicable parameters.
2. Sample will be destroyed after 15 days from the date of issue of test certificate unless & otherwise specified.
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4. Sampling not done by us, unless specified.

Report 3: Water from Manyata Embassy Tech Park after being purified by Reverse Osmosis

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PRASAD

ENVIRO LABS PRIVATE LIMITED

Intertek

ISO 9001 : 2015 & ISO 45001:2018 CERTIFIED LABORATORY

Environmental Pollution Testing Services

10/3, 2nd Floor, Lalbagh Road, Richmond Circle, Bangalore - 560 027.

Tel : 2224 0989 Mobile : 98450 34677 E-mail : prasadenvirolabs@gmail.com www.prasadenvirolabs.com

TEST CERTIFICATE

Recognised by CPCB under Environmental (Protection) Act 1986 vide F. No.LB/99/7/2021-INST LAB-HO-CPCB-HO/Pvt-316/ 13588 Dt.15.02.2022

ANALYSIS REPORT OF WATER QUALITY

Name of the Industry:	Test Report No. PA/APC-9/4629-Feb/2023
Lowe's Services India Pvt. Ltd	Date of Report: 02.03.2023
Level 2, Willow – L2, Manyata Embassy Tech Park	Lab Ref: Data Sheet No. 6386/Feb'2023
Nagavara, Bengaluru – 560045	Page: 1 of 3

Date of sample collected: 22.02.2023

Particulars of Sample: RO Plant – Drinking Water

TEST RESULTS

Sl. No	Parameter	Test Results	Max. Permissible Limit as per IS: 10500:2012	Method of Test
1	Colour, Hazen	2.0	5 Max.	IS:3025 [P-4]
2	Odour	Agreeable	Agreeable	IS:3025 [P-5]
3	Taste	Agreeable	Agreeable	IS:3025 [P-7]
4	Turbidity, NTU	Nil	1.0 Max.	IS:3025 [P-10]
5	pH	7.21	6.5 -8.5	IS:3025 [P-11]
6	Total Hardness (CaCO3), mg/L	2	200 Max.	IS:3025 [P-21]
7	Iron (as Fe), mg/L	0.1	0.3 Max.	APHA
8	Chloride (as Cl), mg/L	6	250 Max.	IS:3025 [P-32
9	Residual free Chlorine, mg/L	ND [DL-0.1]	0.2 Max.	IS.3025 [P-26]
10	Fluoride (as F), mg/L	0.2	1.0 Max.	IS:3025
11	Total Dissolved Solids, mg/L	36	500 Max.	IS:3025 [P-416]
12	Calcium (as Ca), mg/L	6	75 Max.	IS:3025 [P-40]
13	Magnesium (as Mg), mg/L	2	30 Max.	IS:3025 [P-46]
14	Copper (as Cu), mg/L	ND [DL-0.025]	0.05 Max.	APHA
15	Manganese (as Mn), mg/L	ND [DL-0.05]	0.1 Max	APHA
16	Sulphate (as S04), mg/L	3	200 Max	IS:3025 [P-24]
17	Nitrate (as N03), mg/L	1	45 Max.	IS:3025 [P-16]
18	Phenolic substances (as C6HsOH), mg/L	ND [DL-0.0005]	0.001 Max.	IS:3025 [P-40]
19	Mercury (as Hg), mg/L	ND [DL-0.0005]	0.001 Max.	IS:3025
20	Cadmium (as Cd), mg/L	ND [DL-0.001]	0.003 Max.	APHA
21	Selenium (as Se), mg/L	ND [DL-0.005]	0.01 Max.	APHA
22	Arsenic (as As), mg/L	ND [DL-0.005]	0.01 Max.	IS:3025 [P-24]
23	Cyanide (as CN), mg/L	ND [DL-0.025]	0.05 Max.	IS:3025 [P-34]
24	Lead (as Pb), mg/L	ND [DL-0.005]	0.01 Max.	APHA
25	Zinc (as Zn), mg/L	ND [DL-0.1]	5.0 Max.	APHA
26	Anionic detergents (as MBA5), mg/L	ND [DL-0.1]	0.2 Max.	APHA
27	Chromium (as Cr), mg/L	ND [DL-0.025]	0.05 Max.	APHA
28	Mineral Oil, mg/L	ND [DL-0.0005]	0.5 Max.	APHA
29	Total Alkalinity, mg/L	10	200 Max.	APHA
30	Aluminum (as Al), mg/L	ND [DL-0.02]	0.03 Max.	APHA

ND=Not Detected; DL= Detection Limit

V.B.L.D
Analysed By

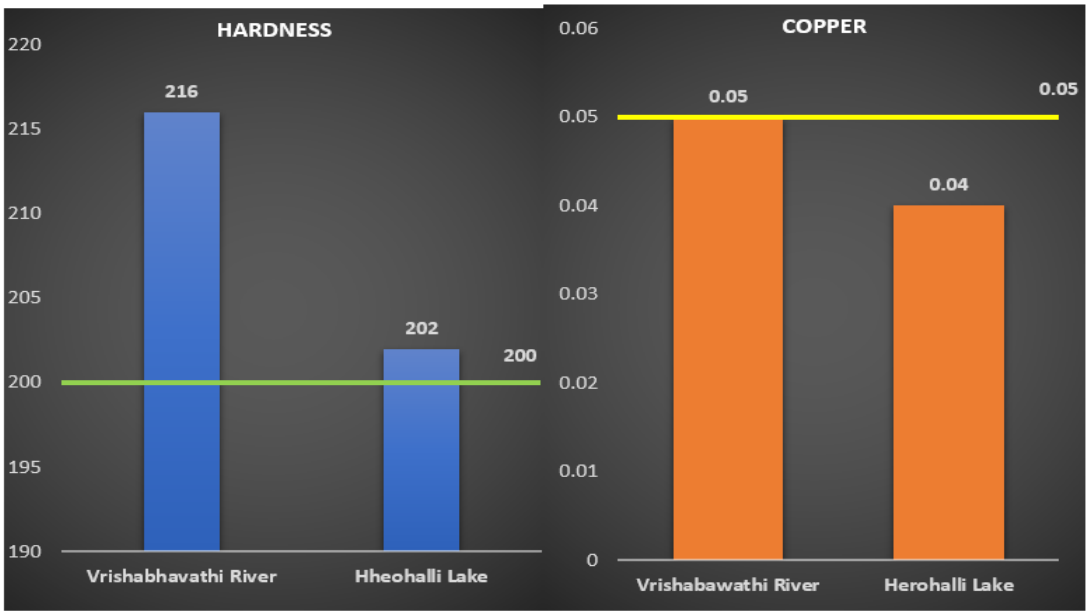
Laboratory Head

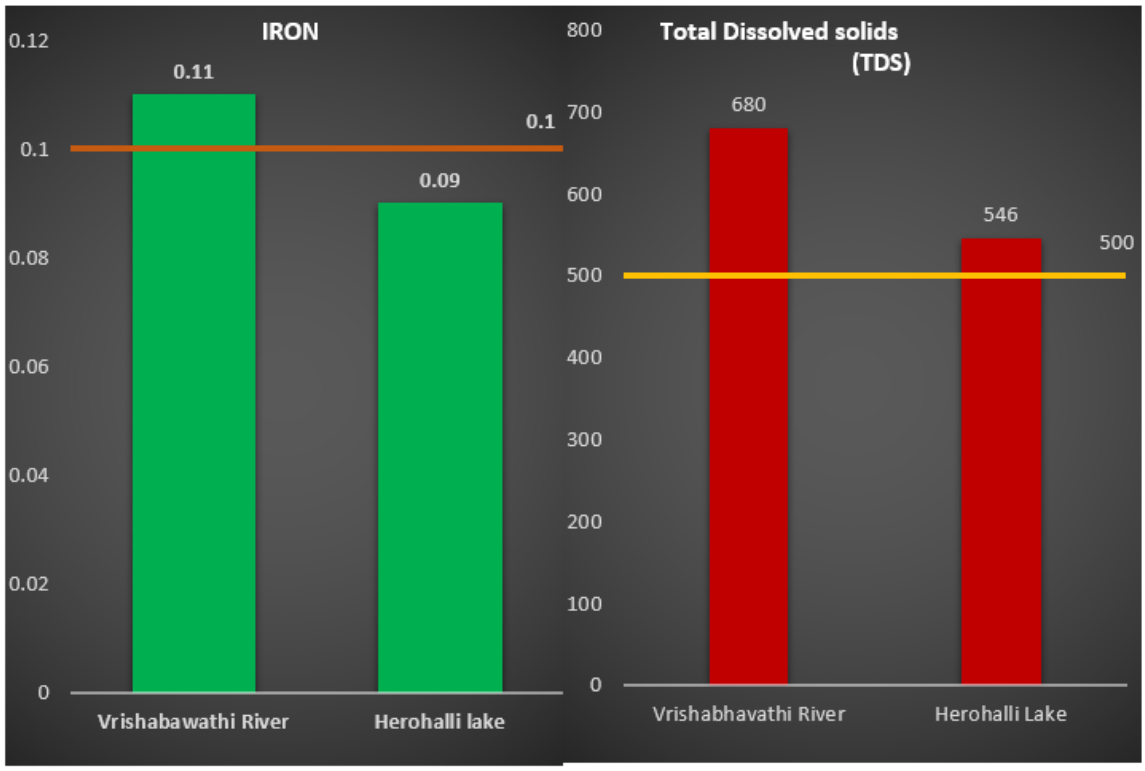
Note : 1. The results listed refer only to the tested samples & applicable parameters.
2. In case of dispute our liability is limited to the billed amount received by us.
3. Samples will be preserved for one week on request.
4. This certificate shall not be reproduced in part or full and cannot be used as a evidence in the court of law.

Air - Water - Noise Sampling , Analysis & Testing Laboratory

Results and Discussions

The water samples were analyzed for various parameters incl. pH @ 25-degree, Temperature, DO, BOD, COD, TSS, Turbidity, TDS, Calcium, Magnesium, Total Hardness, Total Alkalinity as CaCO3, Chlorides, Fluorides, Nitrates, Sulphates, Hexavalent–Chromium as Cr6+, Iron, Copper, Lead, Nickel, Zinc, Faecal-Coliform/100ml.





The major parameter that has significantly crossed the limit is the Total Dissolved Solids. Which is supposed to be 500 mg/L. Even in a clean water source like **REPORT 1**, it is 546 mg/L and in **REPORT 2** it has gone up to 680.

Hence, rapid population growth and industrialization have brought about resource degradation and a decline in environmental quality.

Other metal concentrations are primarily within the allowable limit because these samples were taken from water within 300 feet, but heavy metal concentrations substantially increase below 600 feet. So, it is important to prevent the over accumulation of these contaminants, as they are then transported to the soil and ultimately the food chain. **Report 3** shows the status of drinking water after being purified by RO plants. The test results shows that the total hardness is reduced by 99% and upto 93% of dissolved solids were removed. Copper, mercury, lead, zinc and many other metals were not detected after being purified. Minute amounts of elements like calcium, magnesium, ironand chloride were detected with chloride being purified up to 92%. The survey conducted in Kamakshipalya. the place from where the water sample report 1 was collected. Our survey included a simple questionnaire and some of the questions were as follows:

1. How is this water being used.
2. Why is this water still in use when it's clearly from a contaminated source?
3. How is this water affecting the workers.
4. The steps thatwere taken by the workers to purify the water themselves.
5. Has there been any external help from the government authorities to improve living conditions of these workers.
6. Knowledge about the contaminated water

The responses to each of these questions was as follows:

1. The majority of these workers use water primarily for exterior uses like laundry and cleaning. It was employed in the metal fabrication business for cooling procedures and dust cleaning processes, as well as in the textile industry that we visited to wash or rinse some of the cloth that was present.
2. Because these industrial towns are remote, there are no local clean water sources, which is one of the main justifications these workers gave when asked why they still use contaminated water. The second is that, despite making up a small percentage, some of them are unaware of the danger that these contaminated waters provide.
3. While few of them claimed to have minor skin rashes and cracks on their body, the other told that few fell sick repeatedly. And all seemed to blame the water. This can be true as exposures to toxic water can cause skin irritations, respiratory problems and other illnesses. The other problem that seemed interesting was given by the owners who claimed to have spent a lot of money cleaning the incoming water source and still somehow could not avoid it fully. Hence, they think it isn't economical.
4. The only way of purification known to these workers was boiling. This is also the case in most rural areas too
5. The responses to this differed from person to person. While some spoke in favor of the government, claiming that they allocated funding for the advancement of factory workers. Others claimed that many of these employees still struggle to make a living and that government initiatives are insufficient.
6. The surprising thing was a bunch of people didn't even realize that the water they were consuming was contaminated and wasn't suitable for drinking. Hence awareness plays a key role in saving many lives

Another data found was the status of vrishabhavathi river in 2009.

Parameteres	IS Standards	Results
Temperature	-	25
pH	6.5-8.5	7.16
EC in μ mhos/cm	-	1120
TDS mg/lt.	2000	658
Salinity mg/lt.	-	723
Total Hardness mg/lt.	600	420
Total Alkalinity mg/lt.	600	300
Cd mg/lt.	0.01	nd
Zn mg/lt.	15	0.23
Ni mg/lt.	-	0.035
Cu mg/lt.	1.5	0.02
Cr mg/lt.	0.05	0.1
Fe mg/lt.	1	1.9
Mn mg/lt.	0.3	0.381
Cl- ppm	1000	155
Na mg/lt.	-	45
Ca mg/lt.	200	50
K mg/lt.	-	24
Mg mg/lt.	30	11
Non carbonate hardness	-	20
Sulphate mg/lt.	400	81
Nitrate mg/lt.	100	5.5
COD mg/lt.	10<	125
BOD mg/lt.	3	40
Pb mg/lt.	0.05	0.13

Within a span of 14 years, the TDS of the river has elevated. This shows that contamination of water is only having an upper trend and has no sign of stopping. A freshwater lake or river when maintained free from pollution can offer many beneficial uses in an urban area. Lakes provide life to various forms of flora and fauna, food for the local populace, pollution sink, and groundwater recharge.

After references from various books some of the major threats, sources of ingestion, toxicity and treatment for some of the heavy metals were found.

Lead (Pb)- One of the major sources of its consumption was the water supply pipes, as the houses of Bengaluru that were built in the early 2000s used lead soldering to connect these pipes. Hence when they start to corrode lead started to enter our drinking water. Especially since waters with high acidity and low mineral content is corrosive to fixtures and pipes. The other sources include auto batteries, lead crystals, etc.Acute exposure to bloodlead levels can cause impaired neural transmission and neural cell death. Subclinical exposures in children are associated with anemia, mental retardation, and deficits in language, motor function, balance, hearing behavior, and school performance. Impairment of IQ appears to occur at even low levels of exposure. In Adults chronic subclinical exposures are associated with an increased risk of anemia or degenerative disorders, damage of nerves outside the brain and spinal cord (mainly motor neurons), impairments of reaction time and hearing, hypertension, ECG conduction delays, hypertension, higher risk of cardiovascular diseases and death. The common diagnosis includes abdominal pain, irritability, lethargy, anemia, convulsions and comma. Children with high blood lead levels are may also see 'lead lines' on long bone X-rays. In adults' acute exposure to lead causes similar symptoms as in children with the addition of headaches, myalgias, depression and impaired short term memory loss. Lead exposure at community level has also been associated with the increased risk of hearing loss and Parkinson's disease The most important component of treatment for metal toxicity is the termination of the source. Identification and the correction of exposure sources is critical. If the exposure is highly toxic hospitalization may be the only way. Correction of iron, calcium and magnesium deficiencies through proper diet also will lower lead toxicity. Intake of vitamin C and calcium supplements have been shown to lower blood lead levels.

Cadmium (Cd)- The first thing that comes to mind is the 'Itai-Itai' which is a disease caused by cadmium exposure, produced as a result of human activities related to industrialization it was first recognized in Japan as a result of contamination of food and water by mining effluent. The word 'Itai-Itai' (Ouch-Ouch) was used because cadmium induced bone toxicity led to painful bone fractures. The other sources include disposals from battery and plastic industries, tobacco and ingestion of food with concentrated amount of cadmium (grains, cereals, etc.). The common toxic effects include pneumonia (which is caused due to the inhalation of cadmium and takes affect after 4-24 hrs), anosmia (loss of smell) and the yellowing of teeth.The diagnosis also includes chest pain, fever, nausea, cramps and as stated before bone pain and fractures. However, cadmium poisoning does not have any effective treatment.

Arsenic (As)- It is naturally present at high levels in the groundwater of several countries and is highly toxic in inorganic form. Long-term exposure to arsenic from drinking water and food can cause cancer and skin lesions. It has also been associated with diabetes and cardiovascular disease leading to increased death in young adults. Moderate levels of exposure have been clearly linked with cancer in skin, bladder, kidney, Liver and lung. The magnitude of these risks also intensifies by smoking. The other sources include the pesticides and herbicides dissolved in deep water wells.Metabolism of arsenic include inorganic arsenic which is readily absorbed in lungs and isolated in Liver and kidneys and also persists in skin and nails. Hence hygiene plays a really important role. But it does saturates overtime.The common diagnosis includes nausea, coma, seizures and abdominal pain

Some of the innovative prevention methods are listed below:

Phytoremediation: The process involved in phytoremediation include accumulation of heavy metals by the plant and then disposing or recovering their tissue for extraction of metals.Phytoremediation has many categories, one of them being

Rhizofilteration. It is the process where the plants in the water absorb heavy metals due to the surface area of their roots. These heavy metals are either stored in roots or transported to the biomass of the plant. The plants suitable for rhizofiltration can remove toxic metals from a solution using rapid growth root systems. The process of phytoremediation can months to years. It mainly depends on the plants and the level of contamination of heavy metals in water. This process is still considered because it is a green and effective method of purification. It is also cost effective and does less damage to the environment around it, thus reducing the clean-up charges following the process.

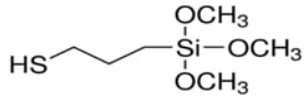
Flocculation: It is the process in which colloids come together to form larger particles called 'flocs', by the addition of a chemical called a flocculant. Typical flocculants include Alum and Ferrix as they work well with hugh turbidity fluid mixtures. This method relies on neutralization, absorption and chelate precipitation. But it is a very efficient, economical, convenient, and widely used method for heavy metal removal.

Electrodialysis: Electrodialysis is an emerging method to remove and recover metals. This is a membrane-based separation process that removes heavy metals from the water by partial separation of the components of ionic solutions using an electric current. The membrane used in this process is usually a polymer laced with nanoparticles as they are very stable in water even at high heat.

Precipitation: Despite being widespread and straightforward, this method of purification is remarkably efficient. Most commonly two types of methods are used during precipitation, Hydroxide precipitation and sulphide precipitation. The hydroxide method is more commonly used as opposed to sulphide precipitation. Mainly becauseless expensive and help in bulk removal. However, this method is not preferred as metals treated from this process can re-solubilize and create voluminous sludge. The sulphide precipitation on the other hand do not allow metal complexes to re-solubilize, and forms less and more compact sludge compared to hydroxide precipitation. It has disadvantages, like being expensive and emits odour that is mildly disastrous to environment. Some of the equipment that can be added at the backend for filtration of heavy metals are sand filters and ion exchange resins. The Sand Filteris capable of removing insoluble metal hydroxides these filters remove solids during the backwash cycle. It mainly allows for improved effluent quality especially Total Suspended Solids.

Ion exchange: Mainly used for the filtration of precious metals. They contain specialized resins which help in removing troublesome metals. It may also be used as a polish when discharging to surface waters requiring very low metal concentrations.

There are several universities and companies which are researching on different ways for treatment and extraction of heavy metals in water. For example, one of the innovative methods being the use of magnetic nanoparticles coated with silica and functionalised with chelating agents. One of the chelating agents used was the MPTMS (3 Mercaptopropy l) trimethoxy silane)



This chelating agent forms a bond with the heavy metals removing them from the aqueous environment. And since these particles are magnetic a strong magnet can be used to separate from the water and thereby purifying it.

Photocatalysis: When light from natural source like the sun or UV light irradiated on a photocatalyst like titanium dioxide (TiO_2)(semiconductor material) a strong power of decomposition is generated on the surface of semiconductor and because of the lights properties the heavy metals continuously decompose until they become harmless. However some heavy metals are difficult to remove especially mercury and lead due to the stability of the chemical bond. Additionally, the presence of other contaminants can also impact the efficiency of photocatalysis for heavy metal removal.

Microbial Fuel Cell (MFC): Itis the way of generating electricity using bio-catalysts present inside the contaminated water. It comprises of anodic and cathodic chambers separated by a Proton Exchange Membrane or salt bridge. The micro-organisms present in the water are employed as

biocatalyst that oxidises the organic substrate at anode isolating protons and electrons. The microbes present in the contaminated water when connected to the cell release electrons in exchange for oxygen, but when electricity is passed through these electrons take a detour and move towards the circuit where theyparticipateto generate electricity.

The ill-effects of neglecting lake ecosystem have caused urban ecological imbalance, pollution, unhygienic conditions, and floods. The result of the increased population intensified the use of surface water exploitation, due to which inland lakes increasingly are being threatened by sewage disposal.

Hence, lakes, reservoirs, and rivers must be restored. It must be returned to a close approximation of its condition prior to disturbance. This ensures that the ecosystem structure and functions are recreated so that natural dynamic ecosystem processes operate effectively.

The above prevention methods are just a glimpse of treatments that can be done to restore these water bodies and even after lots of research,no particular method is flawless. Hence everyone must contribute in getting rid of this subtle but growing threat. Anyone can make a difference by simply raising awareness of the dangers of heavy metals in the water among friends and family. In addition, they may, for instance, put in a water filtration system at home, andavoid heavy metal-containing items like lead-based paint must be avoided.

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