Chemical Pond Water Contamination–icpms Investigations in the Various Areas of Eluru City, Andhra Pradesh, India-a Case Study.

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Abstract

The several stagnant water resources contamination in urban areas mainly caused by anthropogenic activities and as well as pathogenic organisms. The objective of the present study is to determine the chemical contamination in pond water regarding sudden appearance of health problems among the people of certain areas in Eluru, West Godavari District, Andhra Pradesh, India. The results of ICP-MS investigations showed elemental impurities in water samples and physio-chemical parameters of pond water such as pH, TDS, EC, CC, Total Hardness etc., are studied in detailed.

Introduction

The pond water is natural resource which is rigid by limited area [1]. The volume of ground water in storage exceeds then they deposited rest volume of fresh surface water in the form of ponds, lakes, streams, and rivers etc., [2][4]. This water which occurs in fully saturated soils and geological formations [4][5]. Many animals that live in surrounding area, migrating birds spent their incubation period nearby plants depend on these ponds for a rich source of nutrients and water [3].

Pond water contamination mainly caused by two ways one is anthropogenic activities such as waste disposal including manufacturing and service industries, agriculture activities like pesticides and fertilizers utility, irrigation, domestic waste production by bathing, drinking and washing for humans and other animals etc., [6] Second one is Pathogenic organisms such as facial coliforms, streptococci, Salmonella, algae and fungi etc., occurrence in water may increase the risks of water related diseases and health problems in local residents [6][7][9]. Remedial actions to clean up aquifers are difficult, expensive, and sometimes it's not possible. Many laws and regulations are controlling the water contamination. According to WHO (World Health Organization) [10] [11] water quality will be recommended that the acceptable limits of contaminants in water. Plenty of nations implemented contaminants acceptable levels in water based on the availability of resources in their geographical circumference as follows

1. India follows - Bureau of Indian Standards (BIS)
2. United States follows- The united states Environmental Protection Agency Standards (USEPA standard)
3. European Union follows - the quality of water intended for human consumption (80/778/EEC) and Council Directive 98/83/EC (EU Derectives).

Sample Collection

The Eluru is well connected by road and rail with rest of the country. The city is having only few industries and small-scale industries such as the Incense sticks industry, small-scale chemical industries, hair processing industries, automobile workshops, aquaculture-related labs, water plants etc. The people are mostly in-service sector.

Figure 1: Road map of Eluru City

The sudden appearance of some health problems among people of certain areas in Eluru, West Godavari District, Andhra Pradesh in December 2020, was taken up by a multi-disciplinary team of experts from Adikavi Nannaya University.

The expert team from the University has visited the affected areas on 11th and 12 December 2020 to conduct survey and to collect water samples in Eluru City. The information was collected from the sufferers through questionnaire with the help of teachers and student volunteers of National Service Scheme wings of Adikavi Nannaya University affiliated colleges. The survey data related to symptoms, food and water intake, life style, medical history etc. was analysed. The sufficient quantity of water samples was collected from various sources in the city which are listed and labelled as follows

- A- Pre-filtered Godavari water at Pampula Cheruvu
- B- Filtered Godavari water at Pampula Cheruvu
- C- Municipal water at Arundhatipeta
- D- Bore well water at TurupuVeedhi
- E- Bore well water at DakshinapuVeedhi
- F- Godavari water at Denduluru summer storage tank
- G- Tammileru downstream water
- H- Tammileru water at Ashoknagar Bridge
- I- Krishna canal water at Padamatilakulu before joining Tammileru
- J- Bore well water at Hanuman peta

To analyse the basic water quality parameters the same samples were sent to Laboratory for further analyses.

Waste disposal in water resources by anthropogenic activities solid content dissolved in water due to this the aquatic nature of water resources has been changed [12]. The contaminated water samples may exhibit inorganic ions, such as chlorides, nitrates, heavy metals and complex synthetic organic chemicals etc., [13] [16]. TDS method is useful to measure the dissolved combined contents of all inorganic and organic substances present in water. Typically, TDS concentrations are reported in parts per million (ppm) [14]. This test does not provide the specific water quality that is Elevated Hardness such as mineral content in water, Salty /Taste or Corrosiveness called as aggressive water which is how water dissolves with other materials. Therefore, the TDS test is used as an indicator test to determine the general quality of the water only. The water with high TDS value indicates that water is highly mineralized. Desirable limit for TDS is 500 mg/L and maximum limit is 1000 mg/L which is prescribed for drinking purposes [31]. By examination of the above said water samples Total Dissolved Solids (TDS) are listed below (Figure2) as follows

Based on the above said data the concentration of Total Dissolved Solids in various water samples at Eluru city are found to be within the limit of WHO standards except bore well water at Hanuman peta. It seems to be minor concentration of solids in bore well water at Hanuman peta exceeds the desired limits of WHO.

Due to the occurrence of solids in water samples may analyse for metals. In case of heavy metals in the water samples it may cause toxic nature in human health. Because metals are more soluble in water [15]. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs[17].By examination of the above said water samples for availability of metals listed below (Figure3) as follows

Figure 3: water samples for availability of metals

Based on World Health Organization (WHO) the acceptable concentrations of cited above metals are found to be as follows

Table 1
acceptable concentrations

S. No.	Name of the Element	Acceptable Limit in drinking water	Reference
1	Chromium (Cr)	0.05 mg/L or 50 µg/L	Chromium in drinking-water- WHO (2003)
2	Manganese (Mn)	Not of health concern at levels found in drinking-water	IPCS (1999) Manganese and its compounds & Manganese in drinking-water- WHO (2011)
3	Iron (Fe)	Not of health concern at levels found in drinking-water	Iron in drinking-water- WHO (2003)
4	Cobalt (Co)	—	—
5	Nickel (Ni)	0.07 mg/L or 70 µg/L	Nickel in drinking-water- WHO (2005)
6	Copper (Cu)	2 mg/L or 2000 µg/L	IPCS (1998) Copper & Copper in drinking-water- WHO (2003)
7	Zinc (Zn)	Not of health concern at levels found in drinking-water	Zinc in drinking-water- WHO (2003)
8	Cadmium (Cd)	0.003 mg/L or 3 µg/L	FAO/WHO (2011) Evaluation of certain food additives and contaminants & Cadmium in drinking-water- WHO (2011)
9	Mercury (Hg)	0.006 mg/L or 6 µg/L	IPCS (2003) Elemental mercury and inorganic mercury compounds & Mercury in drinking-water- WHO (2005)
10	Lead (Pb)	0.01 mg/L or 10 µg/L	FAO/WHO (2011) Evaluation of certain food additives and contaminants & Lead in drinking-water- WHO (2011)

By examination of the experimental values of cited above metals and reference values looks like within the limits of WHO standards only. With respect to water one parts per million that is 1PPM is equal to approximately one milligram per litre that is 1mg/L.

The contamination of water by these foreign materials decreases the quality of the water. To identify the quality of the water sample pH indicator is more useful method to determine the water sample is either acidic or basic in nature. pH is denoting as potential of hydrogen or powder of hydrogen [18]. The pH of water is a very important measurement concerning water quality. The range is going from 0 to 14. pH 7 is indicated as neutral. pH of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base [19]. A changing of pH in a Pond/ stream/ lake or a river can be an indicator of increasing pollution or some other environmental factor. pH is really a measure of the relative amount of free hydrogen and

hydroxyl ions in the water. Water that has more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is basic [21]. H can be affected by chemicals in the water, due to this pH is an important indicator of water. WHO has recommended maximum permissible limit of pH for drinking water is 6.5 to 8.5[31]. By examination of the above said water samples for pH is listed below (Figure4) as follows

Based on the above said data the Hydrogen potential (pH) in various water samples at Eluru city are found to be within the limit of WHO standards. Out of which Godavari water at Denduluru summer storage tank and Krishna canal water at Padamatilakulu before joining Tammileru are seems to be slightly basic in nature.

Hardness of water is caused by compounds of calcium, magnesium and by a variety of other metals [22] [23]. Water systems using groundwater as a source are concerned with water hardness, since as water moves through soil and rock it dissolves small amounts of naturally-occurring minerals and polyvalent metallic ions [26]. General guidelines for classification of waters are: 0 to 60 mg/L (milligrams per liter) as calcium carbonate is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and more than 180 mg/L as very hard [24]. Hard water has some benefits to humans, animals and other living organisms. Humans need minerals to stay healthy, and the World Health Organization (WHO) states that drinking-water may be a contributor of calcium and magnesium in the diet and could be important for those who are marginal for calcium and magnesium intake [25]. Hence, the water exceeds the limits of hardness it may spoils the functioning of human organs and it leads to die. According to WHO standards, the permissible range of Calcium should be 100-300 mg/L whereas magnesium is 50 mg/L probably lower than calcium. In some cases, consumers tolerate water hardness more than 500mg/L also [31]. By examination of the above said water samples from various areas the Total Hardness is listed below (Figure5) as follows

Based on the above said data the concentration of Total Hardness (TH) in various water samples at Eluru city are exhibits within the limit of WHO standards only.

Typically, the quantity of dissolved solids in water determines the electrical conductivity. Electrical Conductivity (EC) could measures the ionic process of a solution and it allows to transmit current. Pure water is not a good conductor of electric current. It's a good insulator. If ionic contraction will be increased it will enhance the electrical conductivity of water. According to WHO standards, EC value should not exceeded 400 $\mu\text{S}/\text{cm}$.

Disinfection is one of the most important and unquestionable factors for safe drinking water. The destruction of Pathogenic microorganisms (typically bacterial, viral, protozoan or other bio-logical) chlorine is commonly used as reactive chemical agent [27] [28] [29]. High levels of turbidity of infection diminish the growth of bacteria by chlorine. But higher levels of chlorine concentration give a salty taste to water [30]. Taste thresholds for the chloride anion depend on the associated cations are in the range of 200–300 mg/l for sodium, potassium and calcium chloride. No health-based guideline value is proposed

for chloride in drinking-water [31]. By examination of the above said water samples from various areas the chlorine concentration is listed below (Figure5) as follows:

In the above said various study areas, the chloride content is within the limits of threshold point only.

Declarations

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Figures

Figure 1

Road map of Eluru City

Figure 2

Total Dissolved Solids(TDS)

Figure 3

water samples for availability of metals

Figure 4

water samples for pH

Figure 5

Total Hardness

Figure 6

Electrical conductivity (EC)

Figure 7

Chloride content