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Assessment Of Heavy Metal Concentration In Well Water From Mithsagare Village, Nashik, Maharashtra

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Abstract: *In most countries of the world, ground water and surface water are at a serious risk of pollution due to chemicals used in agricultural activities. Well water is one of the major source of domestic (drinking) water. This study is for the assessment of heavy metal contamination in well water used for domestic purposes. Water samples from the wells are analyzed in the laboratory to asses lead, copper, mercury, chromium, cadmium, iron, zinc, potassium, and phosphate. The results of the analyses were compare with the Standards. The results shows that the conc. of Mg and Mn in well water had higher conc. than maximum permissible limits of standards and the concentration of other heavy metals in well water was at different compliance level with standards. It can be concluded that well water in Mithsagare village (Nashik) is fit for domestic use but that efforts should be made to reduce the Mg and Mn concentration by having control on the anthropogenic factors that lead to such high concentration levels or else soon this source of water may become unfit for domestic use..*

Key Words: *Heavy metals, anthropogenic factors, well water, Contamination, Water quality standards*

1. INTRODUCTION:

Water is the important resource and it is one of the essential commodities of day to day life. [1] Water is necessary for a sustainable economic development of an area. It is a 'Life Sustainer'.[1] Water covers 71 % of the earth's surface. On earth, approximate 96.5% water is found in seas and oceans.1.7% in ground water, 1.7% in ice caps and small fraction in other water bodies.[2] Only one percent of water on the earth comes from sources like rivers, lakes and sustainable aquifers. Increasing world's population is facing water shortages. In Mithsagare village, most of the people depend largely on well water. Rapid growth in population and urbanization, has affected the quality of well water due to over exploitation, and increasing demand for agriculture, domestic and industrial water supply.[3] So preservation and purification of well water is important.

Ground water may be contaminated by different contaminants which have an impact on the health. Due to industrial effluents discharge, and inadequate treatment and solid waste disposal, number of contaminants like heavy metals, nitrates salts enters into the water bodies. Some contaminants occur and move naturally whereas some are due to anthropogenic factors. According to WHO 80% of diseases are arises due to contamination in ground water. In environment the presence of heavy metals has grown because of its large utilization in industries and agricultural activities. Especially the trace metal contamination in ground water shows serious health issues.

Heavy metals are the metallic chemical elements. The term "heavy metals" defined as commonly held for those metals, which have some atomic weight between 63.54 and 200.59 and specific gravity greater than 4. Heavy metals are non-biodegradable and persistent in the environments for long periods, accumulate and not metabolized in other ntermediate compounds therefore they are dangerous and shows serous health issues. Although trace amount of some heavy metals are required by living organisms but excess amount of these metals can cause serious toxic problems to life. Occurrence of heavy metals in ground water and surface water is due to natural sources like naturally occurring minerals containing trace elements in the soil zone or to human activities such as mining, fuels, smelting of ores and improper disposal of industrial wastes.

2. Classification of heavy metals:

Heavy metals are classified into four major groups on their health importance.

Sr. No.	Group	Examples
1	Essential	Cu,Zn,CO,Cr,Mn,Fe
2	Non-Essential	Ba, Al ,Li and Zr
3	Less toxic	Sn and As
4	Highly toxic	Hg,Cd, Pb

3. Health Effects and Sources of heavy metals

Metal	Sources of occurrence	General & Health Effects
Calcium Ca (mg/l)	Minerals containing limestone, dolomite	Poor lathering with soap, deterioration of quality of clothes, incrustation in pipes

Magnesium Mg (mg/l)	Minerals containing limestone, dolomite	Poor lathering with soap, deterioration of quality of clothes, with surface laxatives
Fluoride F (mg/l)	Industrial waste, Geological	Brownish discoloration of teeth, bone damage, Skeletal fluorosis
Copper, Cu (mg/l)	Leaching from copper water pipes and tubing, algae treatment, Industrial and mining waste, wood preservatives, Natural deposits	Anemia, Liver and kidney damage, gastrointenstinal irritations, bitter or metallic taste, plumbing fixtures
Iron Fe (mg/l)	Leaching of cast iron pipes in water distribution system	Bitter or metallic taste, brown-green stains, rusty sediment
Sulphate SO_4 (mg/l)	Animal sewage, Septic system, sewage ,By-product of coal mining, industrial waste, Natural deposits or salts	Gastrointestinal irritation, Taste affected, Corrosion
Manganese Mn (mg/l)	Landfills Deposits in rock and soil	Bitter taste ,brownish color
Nitrate NO_3^- (mg/l)	Livestock facilities, Septic systems, Manure ,Fertilizers, Household waste water, Natural Deposits	Blue baby disease in infants,Methemogloinemia
Nitrite NO_2^- (mg/l)	Fertilisers, waste water	Forms Nitrosamines which are carcinogenic
Zinc Zn (mg/l)	Leaching of galvanized pipes and fittings,paints, dyes ,Natural deposits	gastrointestinal irritations, vomiting, dehydration, dizziness, abdominal pain
Chromium Cr(mg/l)	Septic systems, Industrial discharge, Mining sites, Geological.	Skin irritation, skin and nasal ulcers, lung tumors, damage to nervous system and circulatory system,
Sodium Na (mg/l)	Natural component of water	Salty taste to water
Chloride Cl (mg/l)	Fertilizers, Industrial wastes, Minerals, Seawater	High blood pressure, salty taste, corroded pipes, blackening and pitting of stainless steel
HCO3- (mg/l)	Sewage water, waste	Bitter taste, salty taste
Arsenic As (mg/l)	Previously used in pesticides, Improper waste disposal or product storage of glass or electronics, Mining, Rocks	Weight loss, depression, lack of energy, skin and nervous system toxicity
Cadmium Cd (mg/l)	Sewage, Sludge, Fertilizers, Industrial effluents	Highly toxic ,"Itai-Itai disease", Cardiovascular system affected, hypertension
Lead Pb (mg/l)	Paint, diesel fuel combustion, Pipes and solder, Natural deposits	Bio-accumulation, damage to kidneys, abdominal discomfort, Anemia, irritability
Mercury Hg (mg/l)	Fungicides, Mining, Electrical equipment, plant, Natural deposits	Highly toxic, causes "Minamata" disease, mutagenic, renal disturbances

Table 1. Sources of metals and WHO standards

The present study is carried to evaluate the impact of anthropogenic inputs on quality of ground water w.r.t. heavy metals. The concentration of heavy metals above the acceptable levels can result in serious environmental and health problems. This study is helpful to determine heavy metal concentration in well water from selected areas of Mithsagare village. This paper is therefore for analysis of water quality and heavy metal contamination. The results are compared with WHO standards.

4. Materials and Methods:

4.1 Study area

This study was conducted in Mithsagare village located in Sinner Tehsil from District Nashik(Maharashtra).It is nearly about 48 kilometers away from Nashik city. The village is surrounded by industrial area. Most of the people in Mithsagare village depends on agriculture. Well water is major source of domestic water as well as for agricultural activities. To evaluate the quality of well water in Mithsagare village is important for increasing demand for agriculture and domestic purpose.

4.2 Sample collection, preservation and Storage

Six samples for well water were collected from Mithsagare village to assess the contamination w.r.t heavy metals. Water samples were collected in clean, sterilized and transferant polythene containers. The containers were thoroughly rinsed several times with distilled water. After collecting samples all of them were properly sealed and

correctly labeled to avoid confusion. The collected samples were preserved in refrigerator at 1 to 4 ^{0}C until analysis. The samples were tested in laboratory for the presence of heavy metals in well water.

4.3 Data Analysis

The heavy metal concentration in 6 samples of well water from Mithsagare village, were determined in ppm by using Atomic Absorption Spectrophotometer (AAS). Finally, the analyzed data were compared with WHO standards for drinking water quality.

5. Results and Discussion:

The concentration of heavy metals in well water samples from six (6) locations within Mithsagare village was analyzed. The results as shown in table2.

Parameters	W1	W2	W3	W4	W5	W6	WHO Standard
Calcium Ca (mg/l)	56	66	90	65	50	48	75
Magnesium Mg(mg/l)	16.04	18.65	14.25	15.56	20.61	18.65	2
Fluoride F (mg/l)	0.62	0.42	0.52	0.56	0.73	0.4	1.0
Copper Cu (mg/l)	0.08	0.06	0.10	0.12	0.09	0.01	1.0
Iron Fe (mg/l)	0.3	0.04	0.05	0.06	0.0	0.02	0.3
Potassium K(mg/l)	9.2	20	10	8.5	11	9.5	--
Sulphate SO4 (mg/l)	6	5	7	4	30	5	200
Manganese Mn (mg/l)	0.6	0.4	0.2	0.3	0.5	0.3	0.1
Nitrate NO3 (mg/l)	35.14	49	32	43	33	59	45
Nitrite NO (mg/l)	0.050	0.021	0.062	0.021	0.042	0.013	0.2
Zinc Zn (mg/l)	0	0.1	0	0.2	0	0	5
Phosphate (mg/l)	0.35	0.75	0.3	0.42	0.56	0.47	---
Chromium Cr(mg/l)	0.02	0.01	0	0.02	0.01	0.01	0.05
Sodium Na (mg/l)	115.5	122	152	130	68	149	180
Chloride Cl (mg/l)	102	140.5	122	139	115	80.2	250
HCO3- (mg/l)	42	35	30	45	40	32	100

Table 2. Results of laboratory analysis of well water samples in Mithsagare village.

Magnesium is one of the essential element for proper growth and development of plants. It is constituent in chlorophyll pigment which is responsible for photosynthesis. The high content of Magnesium and Calcium in water results to hardness of water. Poor lathering and deterioration of clothes occurs due to hard water. The analyzed data were compared with WHO standards. The amount of magnesium in well water samples as obtained from laboratory analysis indicates the values higher than permissible limit of 2.0 mg/l required for drinking water quality as shown in table 2.

Iron is naturally occurring metal in nature in the form of ore. Iron enters into the water bodies through leaching of cast iron pipes in distribution systems or naturally. Iron is essential element for dietary requirement for most of organisms. Its defects leads anemia. Excess concentration of iron causes gastrointestinal irritation and increases the growth of iron bacteria that affects the water taste[4]. Iron content in water gives bitter or metallic taste to water. It can also result in gene mutation. The iron concentration of the samples is in between 0.00-0.30 mg/l which is within the permissible limit of WHO standard.

The Manganese is one of the common essential trace element and toxic. Manganese gives a bitter taste to water. It promotes the growth of algae that form a slimy coating in pipes. The values obtained far exceeds the permissible limit of WHO standards.

Zinc is essential trace metal. It enters into water from industrial waste water, galvanic industries etc [4] The high concentration of Zn gives metallic taste to water. The values obtained are below the limit of 5 mg/l compared with WHO.

Trace amount of chromium compound are present in water. It discharged into ground water through refinery industries and alloy industries, or industrial effluents. Excess concentration causes skin irritation, gastrointestinal effects, damage to the nervous system, circulatory system. The analyzed data indicates the values fall within the permissible limits of 0.05 mg/l. shown in table 2.

Copper is one of the heavy metal which enters into ground water due to industrial wastage containing copper, agriculture pesticides and released into drinking water through corrosion of copper pipes. It is essential element but excess concentration in drinking water causes kidney and liver damage in people. Wilson's disease is example of copper toxicity [4]. The values compared with standards are within limit as shown in table 2.

When the chloride content in water is 250 mg/l, then it is detected by salty taste. The chloride content in the water samples are in between 80.2 mg/l to 140.5 mg/l. High concentration in water is due to industrial waste discharges, and use of fertilizers.

Nitrate is major plant nutrient. It enters into water naturally or through sludge, sewage, fertilizers. Higher concentration of nitrate in water causes disease Methenoglobinemia or blue baby disease in infants. Four analyzed samples are within desirable limit of WHO standard but two samples exceeds the limit more than 45 mg/l. It may be due to the contamination of water by human activities.

The Sodium (Na) content in collected water samples varies from 68 mg/l to 149 mg/l. Higher concentration of sodium in water is unsuitable for drinking purpose.[1] The Potassium (K) content in water samples varies from 20mg/l to 8.5 mg/l. Results of the analysis of the heavy metals in water samples of Mithsagare well are given below

6. CONCLUSION:

The assessment of well water quality is necessary because large number of people consume water from wells in Mithsagare village (Nashik). The survey shows that most of the wells are present in agricultural areas. Due to use of fertilizers and industrial waste discharges, sewage, contamination of well water w.r.t heavy metals may occur. The result of the analysis shows that the concentration of elements like iron, copper, potassium,zinc,sodium in well water from Mithsagare village falls within permissible limit of WHO standards. While the concentration of Manganese and Magnesium far exceeds the limit which is unsatisfactory when compared with WHO standard. The concentration of Nitrate in four water samples are within limit but two exceeds the limit. It can be concluded that well water from Mithsagare village is fit for human consumption and suitable for other domestic purposes. But the efforts should be taken to reduce the concentration of manganese and magnesium in well water by controlling anthropogenic factors. Frequent monitoring of well water for contamination by heavy metals is necessary to avoid the human health risk.

7. RECOMMENDATIONS:

- It is recommended that the precautionary measure should be taken immediately to avoid the harmful effects by high concentration of heavy metals on human health.
- To avoid future consequence the frequent monitoring of well water is required by controlling anthropogenic factors.
- Before using well water for drinking purpose the water treatment to reduce Manganese concentration like Ion exchange, Chlorination, Oxidizing filter etc. should be done.

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