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Study of Potability of Ground Water in Selected Areas of Swarnamukhi River Basin, Srikalahasti, Chittoor District, Ahdhra Pradesh

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Abstract: ***In the present work, the potability of ground water in Swarnamukhi river basin, Srikalahasti, Chittoor district, Andhra Pradesh was assessed through various water quality parameters (WQPs) such as pH, Total hardness, Electrical conductivity, Dissolved oxygen (DO), Total acidity, Total dissolved solids (TDS), Total alkalinity, Nitrates, Chlorides, Sulphates, Fluorides, Mercury, Arsenic and Lead. Furtyher the results were compared with Bureau of Indian Standards (BIS) and World Health Organization (WHO). Five ground water samples (S_1-S_5) were collected from the bore wells of Swarnamukhi river basin in and around of Srikalahasti town and analyzed for all the water quality parameters. The present work reveals that the overall ground water quality of Srikalahasti town is poor and not potable. The experimental results suggest the use of indigenous technologies to make water fit for drinking.***

Keywords: Swarnamukhi , Water quality, Alkalinity, Electrical conductivity, TDS

1. Introduction

Water is one of the most precious components of our natural resources.90% of the protoplasm is made of water. Hydrosphere consists of 97% sea water and 3% fresh water. Fresh water resources are streams, springs, rivers, lakes, ponds and ditches. Water pollution is defined as the adding to water of any substance, or the change of physical and chemical characteristics of water in any way, which interferes with its use for human utility. Turbidity, toxicity and increase in the temperature are the three chief aspects of water pollution. Most of the Indian rivers are polluted heavily, more over pure water helps to maintain hygiene of human beings while contaminated one imparts diseases at free of cost [1]. So it is essential to know the whether the water is devoid of contaminants and pathogens.

Water from beneath the ground has been exploited for domestic use, livestock and irrigation since the earliest times. Ground water is almost globally important for human consumption, and changes in quality can have serious consequences. The chemical composition of ground water is a measure of its suitability as a source of water for human and animal consumption, irrigation, industrial and other domestic purposes. It influences the structural and functional aspects of ecosystem. So that it is important to detect change and early warnings of change both in natural systems and its pollution.

The Swarnamukhi River starts in Chandragiri mandal and flows along Tirupati rural, Renigunta, Yerpedu, Srikalahasthi, Naidupetamandals and enters into Bay of Bengal. During the course, the fresh water in river and ground water is polluted due to the dumping and mixing of untreated effluents, solid waste and waste water into river by many industries. The drainage water of Srikalahasti municipality also enters into the river. The municipal authorities also dump the garbage and solid waste materials in the Swarnamukhi River. All these contaminants are polluting the surface water and also the ground water in the course.

The objective of the present work is to determine the ground water quality by analyzing various water quality parameters (WQPs) [2] in swarnamukhi river basin in and around the srikalahasti town. Srikalahasti is one of the holy pilgrim centers in the Chittoor district of AP.

2. Material & Methods

Five ground water samples (S_1-S_5) were collected from the bore wells in Swarnamukhi river basin in and around of Srikalahasti town. The details of sample location have been incorporated in Table 1.The water samples were analysed for various water quality parameters such as Total hardness(TH), Dissolved oxygen (DO), PH, Total acidity(TAC), Total alkalinity (TA), Total dissolved solids (TDS), Electrical conductivity (EC), Chlorides (Cl^-), Sulphates(SO_4^{-2}), Nitrates(NO_3^-), Fluoride(F^-), Mercury(Hg), Arsenic(As) and Lead (Pb) as per the methods described in standard methods for the examination of water and waste water by American public health association[3].

Table1: The details of water sampling location

Water sample	Name of the location
S_1	Sannidhi Street
S_2	Nehru Street
S_3	Gajendranagar.
S_4	Bhahudhurpet.
S_5	MN vada

3. Result and Discussion

The results of various water quality parameters (WQPs) such as pH, Total hardness, Electrical conductivity, Dissolved oxygen (DO), Total acidity, Total dissolved solids (TDS), Total alkalinity, Nitrates, Chlorides, Sulphates, Fluorides, Mercury, Arsenic and Lead were summarized in Table 2.

Table 2: Observed values of WQPs of various ground water samples of Swarnamukhi river basin in and around of Srikalahasti town

S. No	Water quality parameters (WQPs)	Measuring units	Observed values of ground water samples for WQPs				
			S_1	S_2	S_3	S_4	S_5
1	Total hardness(TH)	mg/lit	340	380	295	315	625
2	Dissolved oxygen(DO)	mg/lit	0.45	0.78	1.25	0.96	1.34
3	P^H	-	7.2	7.1	5.8	6.8	6.9
4	Total acidity(TAC)	mg/lit	45	40	58	62	65
5	Total alkalinity (TA)	mg/lit	370	610	495	340	620
6	Total dissolved solids(TDS)	mg/lit	721	780	648	598	710
7	Electrical conductivity (EC)	µmhos/cm	1109	1200	1340	1683	1720
8	Chlorides(Cl^-)	mg/lit	148	152	260	285	235
9	Sulphates(SO_4^{-2})	mg/lit	38	64	72	115	138
10	Nitrates(NO_3^-)	mg/lit	29	24	15	20	10
11	Fluoride(F^-)	mg/lit	0.1	0.1	0.45	0.2	0.25
12	Mercury(Hg)	mg/lit	<0.001	<0.001	0.001	0.002	<0.001
13	Arsenic(As)	mg/lit	0.051	0.081	0.102	0.095	0.075
14	Lead(Pb)	mg/lit	0.21	0.45	0.61	0.085	0.11

Total hardness (TH) indicates the presence of chlorides, sulphates, carbonates and bicarbonates of calcium and magnesium. Based on the observations of TH, some samples showed high values as compare to permissible limits of BIS and WHO. The results of hardness indicate that, all these water samples are in very hard in nature. Its value should remain below permissible limit to restore the quality of water. To remove excess hardness ion exchange method, reverse osmosis, activated aluminia filters treatments are suggested.

The standard value for dissolved oxygen of drinking water is 4-5mg/lit. The obtained values of different samples were found lower than permissible limits of BIS (4-5mg/lit). If this water is exposed to atmosphere free oxygen reacts with the water and oxygen content improve to required limits then this water can be used for all domestic purposes. The pH value of drinking water is an important index to acidity. The observed range of pH is 5.8 to 7.2. It is observed that S_3 sample lie below the lower permissible limit of 6.5 prescribed by BIS and all other samples are exceeds the desirable limit of pH 7.0 to 8.0 prescribed by WHO. The low pH may cause desorption of metal cations due to competition by hydrogrn ions (H^+) and it alters the taste of water [4].

Total acidity values were observed that ranging between 40-65 mg/lit as $CaCO_3$. Samples S_3, S_4 and S_5 were above the permissible limits of BIS and WHO (50mg/lit) which results the formation of weak carbonic acids. Weak acid due to higher values of dissolved CO_2. This will adversely affect the corrosion rate. Hence the water must be treated before its use for drinking and construction purpose.

Total alkalinity was observed in the range 340-620 mg/lit as $CaCO_3$. Samples S_2 and S_5 were above the permissible limits of BIS. The value of alkalinity in water provides an idea of natural salts present in water. The excess of alkalinity could be due to the minerals, which dissolved in water from mineral rich soil. The various ionic species that contribute mainly to alkalinity includes bicarbonates, hydroxides, phosphates, borates, silicates and organic acids. In some cases, ammonia or hydroxides are also accountable to the alkalinity [5].

Fresh water always contains some dissolved solids. Evaporation method was used to determine the total dissolved solids (TDS) in water samples. TDS of all the samples were in the permissible limit of 500-2000 mg/lit [6, 7].

The conductivity of water samples depends on the ions that are present and the concentration. As concentration of dissolved salts increases, conductivity also increases. The electrical conductivity of most of the samples falls in the desirable limit up to 2000 µMhos/cm. electrical conductivity of samples of very few areas were high and exceeds the permissible limit [8].

Chlorides content ranges from 148-285 mg/lit. Samples S_3 and S_4 were the above the permissible limits of BIS and WHO (250mg/lit). The contribution of chlorides to the ground water is due to minerals like apatite, mica and hornblende and also from the liquid inclusions of igneous rocks. So the samples are not used for drinking or construction purposes until proper treatment are done [9].

The concentration of Sulphates (SO_4^{-2}) in study area ranged between 38-138 mg/lit, it showing SO_4^{-2} present in samples are under desirable limit as prescribed by BIS (200 mg/lit). Sulphates present in ground water samples may be due to the biochemical, anthropogenic or industrial processes. The presence of sulphate in drinking water can cause noticeable taste and very high levels might cause a laxative effect in unaccustomed consumers [10].

The concentration of nitrates ranges between 15-20 mg/lit, which is lower than the permissible limit (45mg/lit) as prescribed by BIS, which in turn indicates that the ground water has not been affected by nitrate. Human and animals waste, industrial effluents, application of fertilizers and chemicals seepage and silage through drainage system are the main source of nitrate contamination of ground water [11].

Fluoride content in the study area varied from 0.1 to 0.45 mg/lit. The samples were found lower than permissible limits of WHO standards (1.5 mg/lit)which indicates water sample is not fit for drinking. Particularly for children to whom fluoride above 1.0 mg/lit is very much essential for the development of their teeth and bones. Fluoride is considered as an essential element though health problem may arise from deficiency or excess amount.

The heavy metals like, Arsenic(As) , lead (Pb) in all samples exceeded WHO limits and mercury(Hg) in all samples are low level of WHO limits for drinking water. The excess

presence of arsenic in water may cause neurological damage, paralysis and blindness. Excess concentration of lead causes damage to the nervous system and causes brain disorders. Excessive lead (Pb) also causes blood disorders in mammals. The excess mercury (Hg) in water can adversely affect growing brains and nervous systems. Long time exposure to arsenic (As) in drinking water can cause cancer in the lungs, skin and kidney. It can also cause other skin changes such as thickening and pigmentation. From the results of the present study, we can suggest the government, to adopt some treatment technologies to minimize these heavy metals in ground water and surface water to provide drinking water to the public.

4. Conclusion

Results of the present study on various water quality parameters (WQPs) of ground water revealed that quality of ground water was adversely affected in the selected areas of Swarnamukhi river basin around of Srikalahasti town. The ground water was not fit for drinking and other domestic purposes. Use of indigenous technologies was suggested to make water fit for drinking.

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