

PHYSICO CHEMICAL CHARACTERISTICS OF WATER AVAILABLE IN KOTTAGUDI VILLAGE OF MADURAI DISTRICT IN TAMILNADU

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Abstract

In order to understand the utility, various physico chemical characteristics of the water of Kottagudi village in Madurai District were studied in the year of 2022. Ecological parameters such as colour, odour, pH value (at 25 °C), total hardness, turbidity, total dissolved solids content, dissolved oxygen content, chemical oxygen demand, biochemical oxygen demand, fluoride content, chloride content, magnesium content, residual free chlorine content, sulphate content, total alkalinity content, iron content, cadmium content, mercury content, arsenic content, chromium content and lead content of various water samples collected from different sampling points (well water, Pond water & Bore well water) in the *Kottagudi village* of Madurai District in Tamil Nadu, India. In order to ensure that the water is safe for drinking and other uses, the above mentioned parameters were analyzed and compared with the standard permissible limits to assess the best designated use of this water for various purposes. Escherichia coli (E. coli) and total coliform study was also made. The results obtained indicate that this water can be used for agricultural purposes, cattle washing, human bathing, etc and proper purification is needed, when used for the drinking purpose.

Key words: Well water; Pond water; Borewell water; Physico Chemical parameters; Water quality analysis.

Introduction

The quality of water (determined by the physical, chemical and biological compositions) is now the concern of experts in all countries of the world; the decision of WHO's 29th Session (May 1976) emphasizes that water delivered to the consumer should meet the high requirements of modern hygiene and should be free from pathogenic micro-organisms and toxic substances [1]. Due to historical, geographical, religious, political, and sociocultural reasons, India has a unique place in the world; however, pollution-causing activities have caused severe changes in aquatic environments over the last few decades [2].

The quality of potable water depends on the water sources like river, pond, well, lake, etc.; and the drinking water could be polluted with pathogens, toxic metals, chemical compounds (such as pesticides and herbicides) and other agricultural and industrial wastes [3]. The pollution of drinking water is responsible for large number of mortalities and morbidities due to water borne diseases like typhoid, cholera, diarrhea, dysentery, hepatitis, as well as many protozoan and helminthes infections. Exposure to chemicals in drinking water may lead to a range of chronic diseases (e.g., cancerous and cardiovascular diseases), adverse reproductive outcomes and effects on children's health (e.g., neurodevelopment), among other health effects [4,5]. Therefore, the quality and nature of water require proper assessment before use which can be done by suitable physical and chemical analyses.

Physico-chemical characteristics of water have been analyzed by several researchers considering water samples from different water resources of the world[6-10]. According to Census 2011 information the location code or village code of Kottagudi village is 640542. Kottagudi village is located in Melur Tehsil of Madurai district in Tamil Nadu, India. It is situated 10km away from sub-district headquarter Melur and 30km away from district headquarter Madurai. As per 2009 stats, Kottakudi is the gram panchayat of Kottagudi village. The total geographical area of village is 1330.39 hectares. Kottagudi has a total population of 3,272 peoples. There are about 910 houses in Kottagudi village. Melur is nearest town to Kottagudi. As per constitution of India and Panchayath Raaj Act, kottagudi village is administrated by poomadevi rav (Head of Village) who is elected representative of the village. Most of these people are Farmers. They have water sources like pond, well, and bore-well water. In the present study, in order to understand the quality of water for drinking purpose, we have selected the above mentioned four water sources by getting samples from them and analysed. Some of the major physico-chemical properties have been determined for these samples and determined their qualities for drinking purpose.

In the present study, in order to understand the quality of water for drinking and other purposes in the above village, we have selected the above mentioned (and available) four water sources by getting samples from them at different places and analyzed physico-chemically. The results obtained are reported and discussed herein.

Experimental Methods

Sample Collection

Water samples were collected in glass bottles having well fitted stoppers. Bottles having holding capacity of about 1 litre of water were necessary for the chemical analysis. For bacteriological examinations bottles with smaller holding capacities were sufficient. Bottles were thoroughly cleaned, filled thrice with Water, thrice emptied before collecting the sample. For collecting the sample of water from the tank the whole bottle with stopper closed was suspended well under the surface of water and then only the stopper of bottle was removed by means of a clean piece of stirring and the bottle was filled. Thus the entry of floating materials was prevented in the bottle. After collecting the sample the stopper in the bottle was well secured and the bottles containing samples of water were labeled stating the source, date and time of collection.

METHODS FOLLOWED

1. Calcium content : Standard Method (IS:3025:Part 40)
2. Chloride content : Argentometric Method
3. Colour : Vision Method
4. Odour : Standard Method (IS:3025:Part 05)
5. pH value at 20 C : Syntronics digital pH meter.
6. Magnesium content : Standard Method (IS:3025:Part 46)

7. Residual Free Chlorine content : Standard Method(IS:3025:Part 26)
8. Sulphate content :Standard Method (IS:3025:Part 24)
9. Total alkalinity content : Standard Method (IS:3025:Part 23)
10. Total dissolved solids content : Gravimetric method
11. Total hardness :EDTA Method
12. Turbidity content :Standard Method(IS:3025:Part 10)
13. Iron content :Standard Method (IS:3025:Part 53)
14. Cadmium content :Atomic Absorption Spectral analysis
15. Mercury content :Standard Method (IS:3025:Part 48)
16. Arsenic content :Standard Method (IS:3025:Part 37)
17. Chromium content :Standard Method (IS:3025:Part 52)
18. Lead content :Standard Method(IS:3025:Part 47)
19. Dissolved Oxygen content :Titrimetric Winkler Method
20. Chemical oxygen demand :Refluxed Method
21. Fluoride content :Standard Method (IS:3025:Part 60)
22. Bio-chemical oxygen demand :Oxygen depletion method
23. Escherichia coli : Most Probable Number (MPN) Technique
24. Total coliform :Most Probable Number (MPN) Technique

Physico-chemical Analysis

The physico-chemical parameters such as colour (the true colour of water from which the turbidity has been removed), odour (a quality factor affecting acceptability of drinking water), pH value (the measure of acidity, H^+ ion concentration, at 25 °C), total hardness (the measure of calcium and magnesium presence), turbidity (the reduction of transparency), total dissolved solids (TDS) content (the measure of particulate solids presence at 105 °C), dissolved oxygen content (the measure of oxygen presence), chemical oxygen demand (COD), biochemical oxygen demand (BOD), fluoride content (the measure of fluoride presence), chloride content (the measure of chloride presence), magnesium content (the measure of magnesium presence), residual free chlorine content (the measure of residual free chlorine), sulphate content (the measure of sulphate presence), total alkalinity (the quantitative capacity to react with a strong acid to a designated pH), iron content (the measure of iron presence), cadmium content (the measure of cadmium presence), mercury content (the measure of mercury presence), arsenic content (the measure of arsenic presence), chromium content (the measure of chromium presence) and lead content (the measure of lead presence) were determined for all the four water samples considered in the present study by applying the available standard techniques [11-13].

Results Obtained

The results obtained in the present study are provided in Table 1 along with the measurement details (the parameters tested/analyzed with the instrument/method used) and the maximum acceptance limit (the prescribed guideline values [14]). The water samples collected from are represented herein as Sample I, Sample II and Sample III respectively.

The colour and odour of all the four samples considered is found to be acceptable and agreeable as with the guideline prescription. The pH observed for Sample I is slightly more (by 0.3) than the acceptable limit (8.5); and the turbidity observed for Sample II is slightly more (by 0.15) than the acceptable limit (1.0). The cadmium and mercury contents in all the four samples are observed to be very much higher than the acceptable limits (see Table 1); so, purification is required for all the samples in this regard. The biological parameters like E. coli and total coliform have been determined, and thereby, the coliform growth is found to be present in all the three samples considered (see Table 1); however, this coliform growth is considered to be unwanted and is required to be removed before consuming the water.

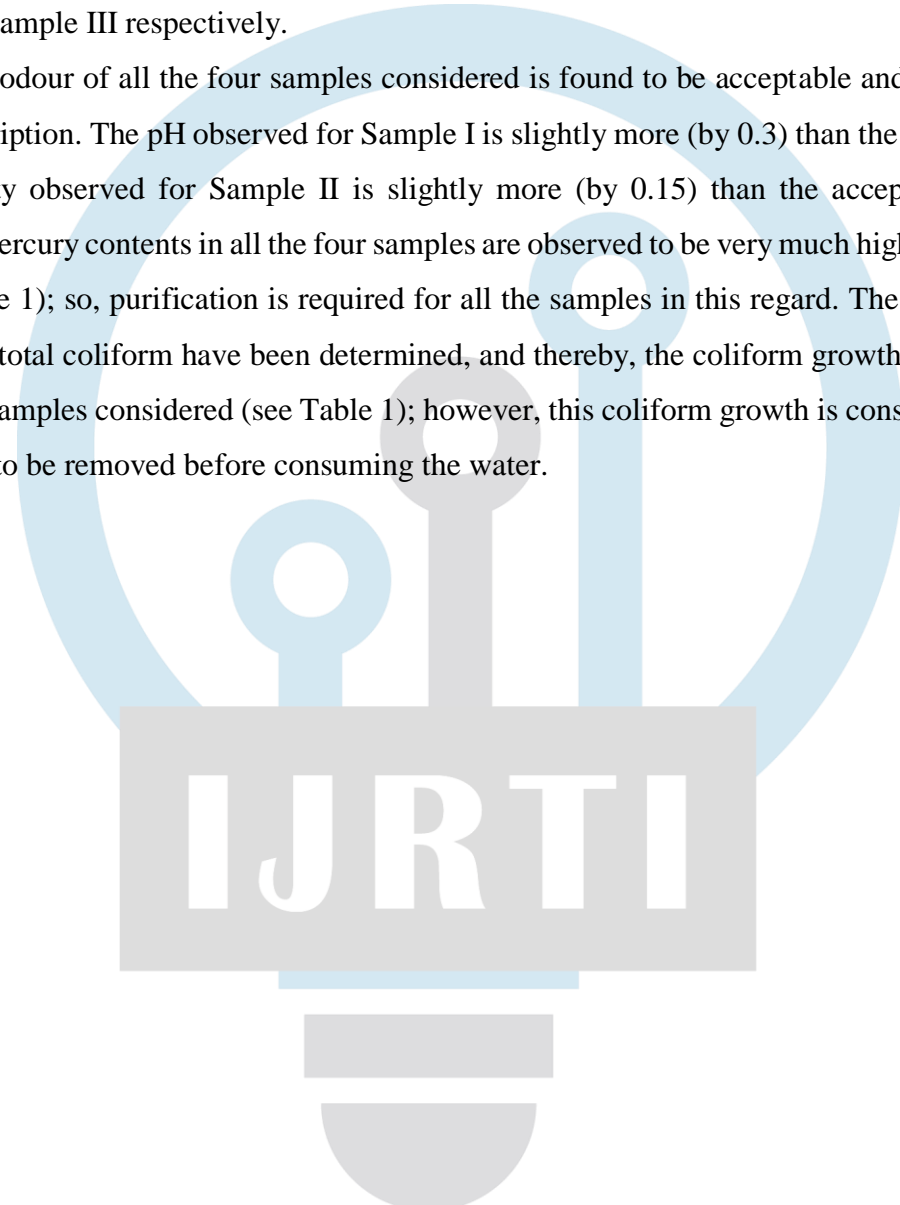


Table 2: Parameters tested/analyzed with the instrument/method used and the results obtained along with the maximum acceptance limit prescribed.(Kottagudi)**Sample I(Well water)**

Calcium, chlorides, magnesium, sulphates, TDS, hardness, etc. within the standard limits and alkalinity & pH beyond the limits. Fe, Cd, Hg, As, Cr & Pb are found to be below the detectable limits. Micro biological parameters such as Escherichia coli and total coliform growth is very high. From this we can understand that this sample does not meet the requirements of drinking water quality as per IS: 10500. In order to use this as drinking water it has to be purified to reduce alkalinity, pH and Coliform growth.

SR. NO.	PARAMETERS (UNITS)	RESULTS OBTAINED FOR			Max Acceptance Limites Of IS:10500:2012
		Sample I	sample II	Sample III	
1	Calcium(mg/L)	112	32	224	75
2	Chlorides(mg/L)	127	48	28	250
3	Colour(Hazen)	<1.0	<1.0	<1.0	5.0
4	Magnesium(mg/L)	18	8.0	51	30
5	Odor	Agr	Agr	Agr	Agreeable
6	pH Value @25 C	7.2	7.6	6.5	6.5-8.5
7	Residual Free Chlorine(mg/L)	<0.1	<0.1	<0.1	0.2
8	Sulphates (mg/L)	16	3.0	11	200
9	Total Alkalinity(mg/L)	263	100	219	200
10	Total Dissolved Solides @105 C(mg/L)	723	191	1854	500
11	Total Hardness (mg/L)	352	113	766	200
12	Turbidity (NTU)	<0.5	<0.5	<0.5	1.0
13	Iron (mg/L)	0.01	0.01	0.01	0.3
14	Cadmium(mg/L)	0.01	0.01	0.01	0.003
15	Mercury (mg/L)	0.01	0.01	0.01	0.001
16	Arsenic(mg/L)	0.01	0.01	0.01	0.01
17	Chromium(mg/L)	0.01	0.01	0.01	0.05
18	Lead (mg/L)	0.01	0.01	0.01	0.01
19	DissolveOxygen(mg/L)	5.1	6.2	6.2	NA
20	Chemical Oxygen Demand (mg/L)	<4.0	32	<4.0	NA
21	Fluoride(mg/L)	<0.1	<0.1	<0.1	1.0
22	Bio Chemical Oxygen Demand @ 27 Cfor 3d	<1.0	2.1	<1.0	NA
23	Escherichia coli (MPN/100ML)	27	900	17	Absent
24	Total Coliform(MPN /100ML)	170	1600	110	Absent

Sample II(Pond water)

Calcium, chlorides, magnesium, sulphates, TDS, hardness, alkalinity, pH within the limits. Cd, Hg, As, Cr & Pb are found to be below the limits. Micro biological parameters such as Escherichia coli and total coliform growth is very very high in Sample II. Turbidity is beyond the limit (too high). From this it is understood that this sample does not meet the

requirements of drinking water as per IS: 10500. In order to use this as drinking water it has to be purified to reduce turbidity and Coliform growth at least.

Sample III(Bore well water)

Calcium, chlorides, Mg, sulphates, TDS, total hardness, total alkalinity beyond the limits.

Fe, Cd, Hg, As, Cr & Pb are found to be below the limits. Micro biological parameters such as Escherichia coli and total coliform growth are very high. Turbidity is beyond the limit. From this it is understood that this sample does not meet the requirements of drinking as per IS: 10500. In order to use this as drinking water it has to be purified to reduce calcium, Mg, chlorides, sulphates, TDS, total hardness, total alkalinity and coliform growth.

DISCUSSION AND CONCLUSION:-

Three different samples have been collected for analysis. As per the Indian Standard all the four samples collected are not up to the level of using for drinking purpose. However samples I & II & III have less impurities/unwanted items than the other samples. If this water has to be used for drinking purpose then we have to purify the water to reduce the unwanted items present in it. At present Kottagudi village people are using Panchayath water and Borewell water for the drinking purpose. However as per the results obtained in the present study they have to be purified further for healthy living. As per the current water quality standards, the water available (from the three sources considered) in the village is unfit for human consumption and can be noted as polluted water.

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