



The Study of Water Quality at Madurai, Tamilnadu, India

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ABSTRACT

Assessment of physico-chemical parameters of water at six places in Madurai were carried out. Five samples were taken from bore well, and one from Corporation pipe supply. The chemical quality was compared with the drinking water quality standards. Several parameters like pH, turbidity, electrical conductivity, chloride, sulphate, total hardness, alkalinity, total dissolved solids, dissolved oxygen, and biochemical oxygen demand were analysed. The study indicates that bore well water except at site S₃ is unfit for drinking. Corporation pipe supply water and bore well water sample of S₃ can be used for drinking purpose after pretreatment.

INTRODUCTION

Madurai is an important city in Tamil Nadu. It is in the centre of Tamil Nadu and is well connected by rail, air and road. Daily, thousands of people visit the Meenakshi temple, as it is one of the oldest and important pilgrim centres. In Madurai, there is a river, Vaigai, which however remains dry for most part of the year. Hence, the main source of water is bore well water. But, the water quality is very poor with salty taste in many places. For drinking purpose, people are dependant on Corporation water supply. In many places inside the city, water is supplied through pipeline, and in other places and outskirts, water is supplied by lorry. It is clear that the bore well water, which has a salty taste, is not fit for drinking, and in places the water is tasteless. The water quality is not clearly known because of no previous study. Hence, physico-chemical analysis has been carried out on five bore well water samples and the Corporation water supply.

MATERIALS AND METHODS

Sampling: Samples of bore well water and Corporation water supplied by pipeline in Madurai were collected in high grade plastic bottles of one-litre capacity after rinsing them with distilled water and thrice with the sample water before collection. The location and source of water samples are given in Table 1.

Water analysis: Samples were brought to the laboratory and the parameters like pH, electrical conductivity and total dissolved solids of water samples were measured immediately. Other physico-chemical parameters were analysed within 36 hours. Standard methods were adopted for the analysis of the water samples (APHA 1989).

RESULTS AND DISCUSSION

The water quality data of physico-chemical parameters of the study are given in Table 2. The data have been compared with Bureau of Indian Standards (BIS 1998) drinking water standards.

Colour and taste: In the present investigation the colour, taste and odour of the water samples were noted at the sampling point itself. All the six samples of water were found to be colourless and odourless. The taste of the samples S_2 , S_4 and S_5 was salty.

pH: The values of pH of the water samples varied from 7.8 to 8.5. The recommended value of pH for drinking purposes is between 6.5 and 9.2 (BIS 1998). In the present study all the water samples analysed were above the permissible limit but within the excessive limit. However, higher values of pH hasten the scale formation in water heaters and reduce the germicidal potential of chlorine.

Electrical conductivity: The values of electrical conductivity varied from 290 to 2800 $\mu\text{mhos/cm}$. The excessive limit is prescribed as 1400 $\mu\text{mhos/cm}$. Only the samples S_3 and S_6 have electrical conductivity below the excessive limit. The higher values of electrical conductivity in these samples clearly indicate that the water from these sources is not fit for human consumption. The high electrical conductivity values may be due to the natural concentration of ionized substances present in water and due to higher total dissolved solids in the study area.

Sulphate: Sulphate is an important constituent of hardness. Excess sulphate ions have laxative effect and cause adverse effect on human health. They also impart taste to water. The maximum desirable limit of sulphate in drinking water is 200 mg/L and the maximum permissible limit is 400 mg/L. Sulphate levels of water samples are within the desirable limit except the water sample S_5 , wherein the value is above desirable limit but below excessive limit. Higher values of sulphate may cause gastrointestinal diseases in human beings.

Chloride: Chloride is also one of the important parameters to know the quality of water. Sources of chloride include fertilizers, salt, and human and animal wastes. Concentration of chlorides is considered to be indicator of organic pollution of animal origin. The present study shows that chloride values for all the samples are within the desirable limit except the water sample S_5 , wherein the value is above desirable limit but below excessive limit. The high chloride content may lead to high blood pressure in people who use it for drinking. But, all the values are within the BIS excessive limit.

Biochemical oxygen demand (BOD): The maximum desirable limit of BOD for drinking water is 5 mg/L. In the present investigation, BOD values of water samples vary from 1.9 to 7.1. The water samples S_1 and S_6 have BOD values higher than the maximum desirable limit of 5 mg/L. The high BOD values clearly indicate pollution, which may be attributed to the percolation of wastewater loaded with biodegradable compounds. It is important to note that the Corporation water supply has higher BOD.

Total dissolved solids (TDS): Total dissolved solids is an important parameter for drinking water and water to be used for other purposes. It indicates the salinity of water. Water containing more than 500 mg/L of total dissolved solids is not considered desirable for drinking water supplies (Sastry & Rahee 1988). However, in unavoidable cases 1500 mg/L is also used. In the present investigation, TDS varied from 180 to 1650 mg/L. Water sample S_6 has the acceptable value. Water sample S_3 has TDS above desirable limit but below excessive limit. All the other samples have very high TDS values and are unfit for human consumption. TDS concentration above the permissible limit causes gastrointestinal irritation. Hence, water with high TDS values should not be used for drinking purposes. If it has to be used due to scarcity, it can be used after reverse osmosis.

Total hardness (TH): Total hardness levels varied from 83 mg/L to 750 mg/L. Water samples S_3 and S_6 have TH levels within the desirable limit. Water samples S_1 , S_2 and S_4 have TH above the desirable limit but below excessive limit. Water sample S_5 has TH level above the maximum permissible limit.

Table 1: Location and source of water samples in Madurai.

S.No	Sample Code	Location	Source
1	S ₁	Old Kuyavar Palayam	Bore-well
2	S ₂	Krishnapuram Third Cross Street	Bore-well
3	S ₃	Pauthadi Second Street	Bore-well
4	S ₄	Old East Madurai Station Road	Bore-well
5	S ₅	St. Mary's Dairy	Bore-well
6	S ₆	Corporation Supply	Pipe supply

Table 2: The physico-chemical parameters of water samples at the selected places in Madurai, with the standard values for comparison.

S.No.	Parameters	BIS (1998)		S ₁	S ₂	S ₃	S ₄	S ₅	S ₆
		P	E						
1.	pH	6.5	9.2	8.0	7.8	8.5	8.3	7.8	8.2
2.	EC	-	1400	1600	1750	1200	1875	2800	290
3.	Sulphate	200	400	120	95	112	115	230	25
4.	Chloride	250	1000	48	175	68	192	368	19
5.	BOD	-	5	5.3	2.8	4.8	1.9	4.5	7.1
6.	TDS	500	1000	1125	1128	610	1100	1650	180
7.	Total hardness	300	600	480	540	250	515	750	83
8.	Total alkalinity	200	600	400	475	340	550	545	100
9.	DO	-	-	12.8	9.5	10.5	6.8	13.5	8.9
10.	Turbidity	5	25	0.2	0.1	0.2	0.3	0.1	0.1
11.	Colour	-	-	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
12.	Odour	-	-	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
13.	Taste	-	-	Tasteless	Salty	Tasteless	Salty	Salty	Tasteless

where P - permissible limit; E - Excessive limit; All parameters are expressed in mg/L except pH, colour (Hazen units), odour, taste and electrical conductivity ($\mu\text{mhos/cm}$).

Total alkalinity: In the present study total alkalinity values ranged from 100 to 550 mg/L. Total alkalinity value for the sample S₆ is within the permissible limit and for all the other samples, it is above the permissible limit but below excessive limit.

Dissolved oxygen (DO): Dissolved oxygen is a very important parameter. Low dissolved oxygen gives bad odour to water due to anaerobic decomposition of organic wastes (Sallae 1974). In the present study dissolved oxygen value of water samples varied from 6.8 to 13.5 mg/L. The DO level in natural waters depends upon physical, chemical and biological activities prevailing in the water bodies. The amount of DO varies with water temperature and altitude (Chhatwal et al. 1989).

Turbidity: The turbidity values ranged between 0.2 and 0.3 NTU. The BIS acceptable limit for turbidity is 25 NTU. All the water samples analysed for turbidity were well within the permissible limit with reference to the BIS (1998) standards.

CONCLUSION

It is clear from the study that many bore well waters in Madurai, especially S₁, S₂, S₄ and S₅, are unfit for human consumption as these samples have high TDS and electrical conductivity, and salty taste. The water sample S₃ has TDS above permissible limit but below excessive limit. Hence, the water from this bore well can be used for drinking purposes after pretreatment like heating or reverse

osmosis. The Corporation water supply through pipeline (water sample S_6) can also be used for drinking. In this sample BOD is higher than the excessive limit and pH is above permissible limit but below the excessive limit. Hence, this water can also be used for consumption after pretreatment.

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