

CHEMICAL ANALYSIS OF DRINKING WATER OF SURROUNDINGS OF CUTTACK TOWN

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Physico Chemical studies of the underground water of Cuttack Town were conducted during the season of 2023-14, Water samples were collected from four sampling stations and then twenty parameters like temperature, pH, turbidity, electrical conductivity, chloride ion concentration, total alkalinity and hardness, dissolved oxygen, BOD, COD, phosphate & fluoride ion concentration, Nitrate & Nitrite ion concentration. Iron, Zinc, Copper, Manganese ion concentration were measured. The values of these parameters show that the drinking water quality of Cuttack Town is becoming polluted due to untreated industrial and sewage water discharge which can be controlled by adopting standard methods for water treatment.

INTRODUCTION

Water is one of the most essential constituents of the environment. It is the primary need of all vital life processes, Its pollution has become a global problem and several studies have been made from time to time [1-13] but still with increasing population this problem is also increasing. Industries located off the river and coast are disposing effluents of land and are causing threat to ground water pollution.

The natural and man made factors are responsible for water pollution, *viz.*, sewage, sludge, solid wastes, industrial wastes etc. produce many toxic chemicals, hazardous compounds, phenols, aldehydes, ketones, amines, cyanides, metallic wastes, toxic acids corrosive alkalies, oils, greases, dyes, biocides, suspended solids etc. from numerous industries. The physico chemical parameters are disturbed due to introduction of several inorganic ions such as phosphate, chloride, fluoride, nitrate etc. Apart from these ions, introduction of several other inorganic and organic wastes disturb the quality of water, *i.e.*, conductivity, hardness, alkalinity, dissolved oxygen, chemical & biochemical oxygen demand, etc. Increase in the concentrations of these parameters beyond permissible limit pose several pollution problems.

Our present study is aimed at to monitor the overall pollution status of drinking water of Cuttack town with special emphasis on physico chemical parameters. An attempt has been made to determine the suitability of groundwater for drinking purpose and identify the origin of various pollutants including heavy metals in ground water. A systematic physicochemical investigation contains the initial phase of scientifically managing water resources of sampling stations.

The present research study has been undertaken for underground water reservoirs of Cuttack district to generate a case study in our state.

MATERIAL AND METHODS

In the present investigation, drinking water samples were collected from the monitoring points of Cuttack town on seasonal fluctuation basis. The samples were collected according to standard method of collecting samples at international level, i.e., APHA & BIS procedure. Water samples were collected from four stations, i.e., from Station I, Station II, Station III & Station IV in the year 2013-14.

Following Table (Table 1) gives an information about the physico-chemical characteristics of drinking water standards as prescribed by WHO (World Health Organisation) & ICMR (Indian Council of Medical Research).

Table 1 : Drinking Water Standards

	Characteristics	Unit	Tolerance limits recommended by	
			W.H.O.(b)	I.C.M.R.(a)
1.	Temperature	°C	–	–
2.	pH		6.5 to 8.5	7.0 to 8.5
3.	Turbidity	NTU	5	25
4.	Specific conductivity (at 25°C)	mhos/	–	–
5.	Chloride	mg/L	200	1000
6.	Fluoride	mg/L	1	1.50
7.	Alkalinity	mg/L	–	–
8.	Total Hardness as CaCO ₃	mg/L	300	600
9.	Calcium Hardness	mg/L	200	600
10.	Magnesium Hardness	mg/L	100	
11.	Dissolved Oxygen	mg/L	6.0	8.5
12.	Biochemical Oxygen Demand	mg/L	2.5	3

(a) Objectionable, (b) Maximum allowable concentration.

Ref. : WHO Recommendation (1984), Indian Council of Medical Research (1984).

EXPERIMENTAL

1. Temperature : Temperature of the underground water was recorded at the time of collecting the samples.

2. **Turbidity** : It was determined by using Naphelo-Turbidity-Meter.

3. **pH** : It was determined with the help of portable pH-meter previously calibrated by buffer solution of 4.0 & 9.2 pH.

4. **Electrical Conductivity** : It was measured with the help of conductivity meter.

5. **Total Alkalinity** : Total alkalinity was measured by the summation of both phenolphthalein alkalinity (8.2 pH) and methyl orange alkalinity (4.5 pH).

Table 2 : Physico Chemical Analysis of Municipal Tap Water during December 2013 to March 2014

Parameter	Unit	Station-I	Station-II	Station-III	Station-IV
Temp.	°C	20.3	20.9	20.8	20.4
Turbidity	NTU	5	5	6	8
pH	-	7.3	7.3	7.4	7.4
El. conductivity	Mhos/cm	183	167	158	169
Chloride	mg/L	188	210	205	190
Total alkalinity	mg/L	350	430	405	380
Total Hardness	mg/L	275	320	324	298
Ca. Hardness	mg/L	190	214	206	198
Mg. Hardness	mg/L	110	129	94	87
DO	mg/L	4.56	5.59	5.48	3.94
BOD	mg/L	3.74	3.65	9.65	9.00
COD	mg/L	13.6	15.8	18.8	14.7
Phosphate	mg/L	0.28	0.27	0.27	0.29
Nitrate	mg/L	13.0	1.24	1.39	2.75
Nitrite	mg/L	0.018	0.025	0.025	0.006
Iron	ppm	0.339	0.206	0.116	0.334
Fluoride	ppm	0.205	0.195	0.195	0.291
Copper	ppm	0.061	0.073	0.073	0.150
Zinc	mg/L	0.28	0.18	0.18	0.34
Manganese	mg/L	0.195	1.31	1.32	1.33

6. **Total Hardness** : The metallic cations other than those of alkali-metals when expressed as equivalent to CaCO_3 represent the total hardness.

7. **Calcium Hardness**: It was measured by EDTA titration method.

8. **Magnesium Hardness** : It was measured by the following formula:

$$\text{Mg Hardness as mg CaCO}_3/\text{lit}$$

$$\text{Total Hardness as mg CaCO}_3/\text{lit.} - \text{Ca hardness as mg CaCO}_3/\text{lit.}$$

9. **DO** : Dissolved oxygen acts as an index for the suitability of water as regards of life. It was determined by the process of Azide modification Wrinkler's method.

10. **B.O.D.** : Biochemical oxygen demand represents the amount of oxygen required to oxidize the biodegradable fraction of total organic matter in a water body. It is a good indicator of organic pollution. It was determined by dilution and incubation method.

11. **C.O.D.** : Chemical oxygen demand is a measure of oxygen consumed by strong chemical oxidant while oxidizing the available organic matter. It was determined by the help of COD digester.

12. **Chloride Detection** : It was estimated according to Mohr's method.

Table 3 : Physico Chemical Analysis of Dug Well Water during December 2013 to March 2014.

Parameter	Unit	Station-I	Station-II	Station-III	Station-IV
Temp.	°C	20.6	21.6	20.8	20.8
Turbidity	NTU	17	34	19	28
pH	-	7.3	7.0	7.6	7.3
El. conductivity	Mhos/cm	1540	1300	1548	1252
Chloride	mg/L	209	210	186	165
Total alkalinity	mg/L	127	136	120	220
Total Hardness	mg/L	198	125	257	209
Ca. Hardness	mg/L	389	280	393	223
Mg. Hardness	mg/L	86	63	85	100
DO	mg/L	2.29	2.29	2.42	2.44
BOD	mg/L	1.39	1.97	1.87	1.83
COD	mg/L	28.6	38.6	22.0	21.7
Phosphate	mg/L	2.25	1.07	0.19	2.39
Nitrate	mg/L	3.85	6.21	6.7	0.85
Nitrite	mg/L	0.016	0.030	0.027	0.035
Iron	ppm	1.09	1.065	1.868	1.015
Fluoride	ppm	0.159	0.168	0.218	0.126
Copper	ppm	0.038	0.054	0.019	0.283
Zinc	mg/L	0.18	0.19	0.09	0.05
Manganese	mg/L	0.15	0.02	0.22	0.01

13. **Fluoride** : The basis source of fluoride are mineral deposits. Fluoride evaluation was done by Ion-Selective-Electrode using an Ion-Analyser.

14. **Zinc** : It was measured by the Zircon method.

15. **Manganese** : It was measured by Persulphate method.

16. Other inorganic ions such as Phosphate, Nitrate, Nitrite were detected by the help of different reagents and spectrophotometer.

OBSERVATIONS

In our study of nature of water during Dec. 2013 to Mar. 2014 following observations were noticed (Table 2.4).

RESULTS AND DISCUSSION

1. At all the four sampling stations, the fluoride ion concentration was found to be below the prescribed limit of 0.5 mg/L, hence it may cause dental carries if taken upthrough drinking water.

Table 4 : Physico Chemical Analysis of Hand Pump Water during December 2013 to March 2014

Parameter	Unit	Station-I	Station-II	Station-III	Station-IV
Temp.	°C	20.8	20.9	20.5	20.4
Turbidity	NTU	18	10	13	16
PH	-	6.8	7.2	7.1	6.9
El. conductivity	Mhos/cm	734	804	1078	1238
Chloride	mg/L	88	74	98	54
Total alkalinity	mg/L	74	103	95	82
Total Hardness	mg/L	495	419	420	269
Ca. Hardness	mg/L	415	385	357	302
Mg. Hardness	mg/L	66	84	132	167
DO	mg/L	2.98	2.37	2.39	2.86
BOD	mg/L	2.69	1.81	0.955	8.31
COD	mg/L	18.7	13.9	12.3	4.6
Phosphate	mg/L	0.98	1.60	0.72	1.7
Nitrate	mg/L	3.2	1.4	0.95	0.45
Nitrite	mg/L	0.024	0.008	0.004	0.589
Iron	ppm	0.197	0.183	0.127	0.110
Fluoride	ppm	0.076	0.017	0.116	0.064
Copper	ppm	0.157	0.035	0.014	0.243
Zinc	mg/L	0.60	0.28	0.34	0.13
Manganese	mg/L	0.08	0.05	0.05	0.02

2. BOD, which gives an idea of pollution due to domestic wastes, was found to be higher than the prescribed limits (*i.e.*, 2.5 mg/L).

3. The desirable limit of COD is 10 mg/L in drinking water, but in the present study, the values of COD are higher than BOD values which indicate organic pollution in the underground water. It is probably due to the dissolved chemicals present at the surface.

4. Higher concentration of chloride indicates pollution due to industrial effluents.

The values of the other parameters calculated as given in Table 2.4.

Hence these results indicate that drinking water quality of Cuttack town is becoming polluted due to untreated industrial and sewage water discharge in industrial estate.

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