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## Research Article

### ANALYSIS OF WATER QUALITY USING PHYSICO- CHEMICAL PARAMETERS WATER BOARD TANK IN OKAKA, YENAGOA, BAYELSA STATE, NIGERIA

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#### ABSTRACT

The concentrations of physico-chemical parameters and heavy metals in water samples collected from Bayelsa State water Board Tank in Okaka, Yenagoa, Nigeria were investigated, and the water quality was assessed. Weekly Changes in Physicochemical parameters such as pH, Salinity, Conductivity, turbidity, Total dissolved solids, Total suspended solids, NO<sub>3</sub>Cl<sup>-</sup> SO<sub>4</sub><sup>2-</sup> HCO<sub>3</sub><sup>-</sup>, Total alkalinity, Total hardness, Dissolved oxygen, calcium, magnesium, potassium, sodium, manganese, iron, cobalt, copper, lead, zinc, cadmium were analyzed for a periods of four weeks. Comparison with WHO reference standards, studies from other environments and Pearson correlation matrix was attempted. The results of this study were found to be within permissible levels recommended by WHO, 2005.

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## INTRODUCTION

As water is one of the most important compound to living things, it is therefore necessary that the quality of drinking water should be checked at regular time of interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is difficult to understand the biological phenomena fully because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro - biological relationship Basavaraja *et al.*, 2011. WHO, 2011; Prasad *et al.*, 2014 reported that the majority of the populations in developing countries are inadequately supplied with potable water and are thus bound to use water from sources like shallow wells and bore holes that have high potential of contamination and provide the unsafe water for domestic and drinking purposes. Asaolu, 1998; Adefemi and Awokunmi, 2010 mentioned that the increased use of metal-based fertilizer in agricultural revolution of the government could result in continued rise in concentration of metal pollutions in fresh water reservoir due to the water run-off. Also, pollution of drinking water causes water - borne disease which has led to the death of millions of people both in cities and villages. Bayelsa State water board, is the Bayelsa State Government

agency with the statutory responsibility for the production, distribution and management of water resource and infrastructures to meet the numerous water needs of Bayelsans either for drinking and other domestic uses. The study of the physico-chemical parameters and heavy metals in Bayelsa State water board tank in Okaka, Yenagoa has not been undertaken by previous workers. Little or noattention has been focus on the analysis of water quality using physico-chemical parameters Bayelsa state water board tank, therefore literature is very scanty. This present study was carried out to check the water quality and provide information on the level of heavy metals and physico-chemical parameters in this water source to avoid potential health risk.

## MATERIALS AND METHODS

### Description of study area

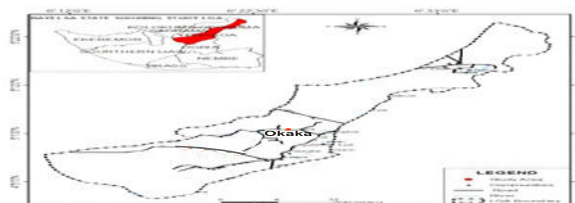


Figure 1 Map of Yenagoa Showing the Sampling locations

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Bayelsa state water is located at Okaka along old Azikoro road, Yenagoa, Nigeria. The study area lies between the coordinates of latitudes 04o15” North and latitude 05o23’ South and longitude 05o22”West and 06o45” East.(Fig 1).

### Sampling and analysis

The concentrations of heavy metals in each water sample were determined using a GBC Avanta PM. Ver 2.02 AAS. The determination of physico-chemical parameters was according to the standards method of (Trivedy and Goel, 1986, APHA 1985, Basavaraja *et al.*, 2011).

## RESULTS AND DISCUSSION

The results of analysis of physico-chemical parameters of the Government of Bayelsa State water board tank are presented in Table 1-2

**Table 1** Results of physicochemical parameters of water samples for four weeks

Parameters	Week1	Week 2	Week 3	Week 4
pH	6.06	6.01	6.11	6.36
Sal(mg/L)	0.023	0.02	0.03	0.03
EC(μS/cm)	73.00	78.67	89.33	86.4
Tur.(mg/L)	0.44	0.34	2.20	1.88
TDS(mg/L)	37	39.83	44.90	43.37
TSS(mg/L)	0.02	0.02	0.43	0.2
NO <sub>3</sub> <sup>-</sup> (mg/L)	0.13	0.13	0.10	0.11
Cl <sup>-</sup> (mg/L)	11.33	11.67	140	15
SO <sub>4</sub> <sup>2-</sup> (mg/L)	0.56	0.59	0.35	0.36
HCO <sub>3</sub> <sup>-</sup> (mg/L)	0.70	1.1	0.47	0.5
TA(mg/L)	9.00	11.7	7.67	10
TH(mg/L)	31.33	44.33	49.00	39
DO(mg/L)	5.07	5.41	5.74	6.07
calcium(mg/L)	5.59	6.96	7.72	8.44
Mg(mg/L)	1.49	1.87	1.16	1.35
K(mg/L)	1.82	1.68	1.96	3.85
Na(mg/L)	4.2	4.01	5.14	5.2
Mn(mg/L)	0.02	0.02	0.01	0.01
Fe(mg/L)	0.13	1.53	5.64	0.54
Co(mg/L)	BDL	0.05	0.07	0.06
Cu(mg/L)	BDL	0.04	0.034	0
Pb(mg/L)	0.07	0.14	0.02	0.26
Zn(mg/L)	BDL	0.09	0.14	0.20
Cd(mg/L)	BDL	0.10	0.10	0.11

Shyamala *et al.*, 2008 reported that pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. pH is considered as an important ecological factor and provides an important piece factor and piece of information on many types of geochemical equilibrium or solubility calculation. The data shows that pH in this study ranged from 6.06-6.35 with a mean value of 6.14±0.16 (Table 1-2). Basavaraja *et al.*, 2011 reported pH value ranged from 7.5 to 8.4 with maximum pH value (8.4) which is alkaline for Hosahalli Tank in Shimoga District, Karnataka, India. Prasad *et al.*, 2014 mentioned maximum pH as 8.8 at sampling location Kadiyampalli and the minimum was 7.7 for Obulavaripalli Mandal of YSR (Kadapa) District, Andhra Pradesh, India. A comparative analysis of pH levels in the water with WHO standards revealed that the results obtained in this study were within the permissible levels of WHO standards (6.5-8.5).

The Concentration (range, mean ± standard deviation, mg/L) for salinity, conductivity (μS/cm) and turbidity in the water ranged from 0.02-0.03, 73-89.33 and 0.34-2.20 with mean

values of 0.02±0.01, 81.85±7.42 and 1.22±0.96 respectively (Table 1-2). Basavaraja *et al.*, 2011 reported that the turbidity of water fluctuates from 3.90 to 14.25 NTU with a maximum value of 14.25 NTU for Hosahalli Tank in Shimoga District, Karnataka, India. A comparative analysis of salinity, conductivity and turbidity levels in the water with WHO standards revealed that the results obtained in this study were lower.

The Concentration (range, mean ± standard deviation, mg/L) for total dissolved solids (mg/L), total suspended solutes (mg/L) and chloride Cl (mg/L) of the water ranged from 37-44.90, 0.02-0.43 and 11.33-15 with mean values of 41.28±3.55, 0.17±0.19 and 13±1.78 (Table 1-2). The total dissolved solids fluctuate from 120 mg/l to 256.4 mg/l. the maximum value (256.4 mg/l) for Hosahalli Tank in Shimoga District, Karnataka, India (Basavaraja *et al.*, 2011). A comparative analysis of total dissolved solids (mg/L), total suspended solutes (mg/L and chloride Cl (mg/L) levels in the water with WHO standards revealed that the results obtained in this study were lower.

**Table 2** The physico-chemical parameters of water samples and WHO standards

Parameters	range	mean±std	variance	WHO, 2005
pH	6.06-6.36	6.14±0.16	0.02	6.5 – 8.5
Sal(mg/L)	0.02-0.03	0.03±0.01	2.51	500
EC(μS/cm)	73-89.33	81.85±7.42	55.03	1000
Tur.(mg/L)	0.34-2.20	1.22±0.96	0.03	0 - 200
TDS(mg/L)	37-44.90	41.28±3.55	12.63	1000
TSS(mg/L)	0.02-0.43	0.17±0.19	0.04	100 - 500
NO <sub>3</sub> <sup>-</sup> (mg/L)	0.10-0.13	0.12±0.02	0.01	100 - 500
Cl <sup>-</sup> (mg/L)	11.33-15	13.00±1.79	3.17	100 - 500
SO <sub>4</sub> <sup>2-</sup> (mg/L)	0.35-0.56	0.47±0.13	0.01	100 - 500
HCO <sub>3</sub> <sup>-</sup> (mg/L)	0.5-1.10	0.69±0.29	0.08	100 - 500
TA(mg/L)	7.67-11.70	9.59±1.70	2.89	100 - 500
TH(mg/L)	31.33-49	40.92±7.58	57.52	100 - 500
DO(mg/L)	5.07-6.07	5.57±0.43	0.19	100 - 500
Ca(mg/L)	5.59-8.44	7.18±1.22	1.59	75 - 200
Mg(mg/L)	1.49-1.87	1.47±0.30	0.09	0 - 200
K(mg/L)	1.68-3.85	2.33±1.02	1.04	0 - 200
Na(mg/L)	4.01-5.20	4.64±0.62	0.39	0 - 200
Mn(mg/L)	0.01-0.02	0.02±0.01	3.33	0 - 200
Fe(mg/L)	0.54-5.64	1.96±2.52	6.26	0 - 200
Co(mg/L)	BDL-0.07	0.04±0.03	0.01	0 - 200
Cu(mg/L)	BDL-0.04	0.02±0.03	0.01	0 - 200
Pb(mg/L)	BDL - 0.26	0.17±0.08	0.01	0 - 200
Zn(mg/L)	BDL - 0.14	0.11±0.09	0.01	0 - 200
Cd(mg/L)	BDL-0.11	0.08±0.05	0.01	0 - 200

The Concentration (range, mean ± standard deviation, mg/L) of total alkalinity, SO<sub>4</sub><sup>2-</sup>(mg/L) and total hardness (mg/L) in the water ranged from 7.67-11.7, 0.35-0.56 and 31.33-49.00 with mean values of 9.60±1.69, 0.47±0.13 and 40.92±7.58 respectively (Table 1-2). Prasad *et al.*, 2014 reported that hardness values ranged from 100 mg/ to 600 mg/L for Obulavaripalli Mandal of YSR (Kadapa) District, Andhra Pradesh, India. Basavaraja *et al.*, 2011 mentioned that the value of hardness fluctuates from 70 mg/l to 142 mg/l with maximum value of (142 mg/l) for Hosahalli Tank in Shimoga District, Karnataka, India. A comparative analysis of total hardness levels in the water with WHO standards (100 -500 mg/L) revealed that the results obtained in this study were lower.

**Table.3** Correlation heavy metals and physicochemical parameters of the water

	pH	Sal.	Cond.	Turd.	tds	Mn	Fe	Co	Cu	Pb	Zn	Cd
pH	1.00											
sal	0.750	1.00										
Cond.	0.549	0.833	1.00									
Turd.	0.650	0.971	0.935	1.00								
tds	0.532	0.823	1.00	0.930	1.00							
Mn	-0.742	-0.970	-0.936	-0.990	-0.929	1.00						
Fe	-0.189	0.447	0.688	0.614	0.699	-0.517	1.00					
Co	-0.418	-0.582	-0.928	-0.739	-0.932	0.760	-0.619	1.00				
Cu	-0.590	-0.301	0.235	-0.064	0.254	0.115	0.625	-0.473	1.00			
Pb	-0.811	-0.775	-0.891	-0.822	-0.885	0.887	-0.290	0.870	0.014	1.00		
Zn	0.768	0.772	0.887	0.787	0.883	-0.853	0.301	-0.899	0.062	-0.996	1.00	
Cd	-0.343	-0.387	-0.810	-0.558	-0.817	0.599	-0.491	0.970	-0.556	0.812	-0.858	1.00

The Concentration (range, mean  $\pm$  standard deviation, mg/L) of dissolved oxygen and Calcium in the water ranged from 5.07-6.07 and 5.59-8.44 with mean value of  $5.57 \pm 0.43$  and  $7.18 \pm 1.22$  (Table 1-2). Basavaraja *et al.*, 2011 reported that the value of DO fluctuates from 7.25 mg/l to 16 mg/l. The maximum values (16 mg/l) for Hosahalli Tank in Shimoga District, Karnataka, India. Prasad *et al.*, 2014 reported that calcium concentration ranged between 40 mg/l to 200 mg/l for Obulavaripalli Mandal of YSR (Kadapa) District, Andhra Pradesh, India. Calcium is directly related to hardness and is the chief cation in the water. A comparative analysis of calcium levels in the water with WHO standards (75 -200 mg/L) revealed that the results obtained in this study were lower. The concentration (mg/L) of magnesium, potassium and manganese varies between 1.49-1.89, 1.68-3.85 and 0.01-0.02 with mean value of  $1.47 \pm 0.30$ ,  $2.33 \pm 1.02$  and  $0.02 \pm 0.06$ . The results of this study were found within permissible limits of WHO.

The concentration (mg/L) of iron, cobalt, copper, lead, zinc and cadmium varies between 0.54-5.64, -0.05-0.07, 0.00-0.04, -0.07-0.26, 0.00-0.14 and -0.10 - 0.11 with mean values of  $1.96 \pm 2.52$ ,  $-0.04 \pm 0.03$ ,  $0.02 \pm 0.02$ ,  $-0.17 \pm 0.08$ ,  $0.11 \pm 0.08$ ,  $-0.08 \pm 0.05$  (table 1-2). It was observed that cobalt, lead and cadmium were below detection limit (BDL) and Cu, Zn, Fe and Mn showed appreciable accumulation in the water samples. A comparison has shown that the results obtained in this study were found to be within the permissible levels given by the WHO standards and agreed with those reported by Adefemi and Awokunmi, 2010

The correlation matrixes for the different water quality variables for the Bayelsa State water board are presented in Table 3. High positive correlation coefficient was observed between the parameters. This could indicate a common source: salinity and alkalinity ( $r=0.971$ ), salinity and chloride ion ( $r=0.923$ ), Ph and chloride ion ( $r=0.861$ ), conductivity and TDS ( $r=0.999$ ), conductivity and calcium ( $r=0.905$ ), turbidity and TDS ( $r=0.930$ ), turbidity and TSS ( $r=0.932$ ), TDS and calcium ( $r=0.901$ ), nitrate and sulphate ( $r=0.966$ ), chloride and sodium ( $r=0.961$ ), carbonate and magnesium ( $r=0.976$ ), calcium and zinc ( $r=0.999$ ), cobalt and cadmium ( $r=0.969$ ) Tale 3

## CONCLUSION

A total of twenty-four variables were examined including heavy metals based on their potential toxic effects include: Cd, Cu, Fe, Pb and Zn. The results showed that the physico-chemical parameters and heavy metals investigated in the water samples from the Bayelsa State water board tank in Okaka, Yenagoa were within the maximum allowed limits and do not pose any treat.

As a principal measure, cooperate bodies and individuals in the study area should be encouraged by environmental protection and health bodies (e.g. Bayelsa State ministry of environment, Bayelsa State Environmental Sanitation Authority and Bayelsa State Ministry of Health) to dispose effluents in a manner that optimizes protection of the environment, avert the use of contaminated drinking water and safeguard outbreak of water borne diseases.

## Competing Interests

Authors have declared that no competing interests exist

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