

Estimations of Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Trace Elements in Borehole Water from Local Government Areas in Plateau State, Nigeria

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Abstract:- This paper presents the results of an investigations into the levels of dissolved oxygen(DO),chemical oxygen demand(COD), chloride, sodium, potassium, lead, arsenic, and cadmium in boreholes water in some local government areas of Plateau State, Nigeria. The study samples comprised samples collected from 50 boreholes located in ten (10) local government areas. The data were collected using standard water analysis procedures, and the results were analyzed using Association of Official Analytical Chemists(2019) manual. The results revealed that all the parameters measured fell within the recommended values for drinking water quality, Though, the Nigeria Industrial Standard(NIS)has the maximum concentration reference ranges for Sodium, Chloride, Lead, Cadmium and Arsenic as 200mg/L,250mg/L,0.01mg/L,0.003mg/L and 0.01mg/L respectively.

Also, the NIS did not have a threshold values for dissolved oxygen (DO),chemical oxygen demand (COD) and potassium for the boreholes water samples. The study concluded that the boreholes water from the study area was generally of good quality and suitable for drinking since there were no contaminations of the water samples by any of the metals, The findings of the study could form the basis for further research and the implementation of appropriate water quality management measures.

I. INTRODUCTION

Water, an essential resource for sustaining life and ecosystems, places great emphasis on its quality (WHO, 2003). As the demand for potable water rises, boreholes emerge as crucial reservoirs, serving domestic, agricultural, and industrial needs. However, the safety and appropriateness of

borehole water hinge on various chemical factors with significant implications for human health and the environment (HEM, 1985).

This article embarks on an exploratory journey to assess essential elements in borehole water, including Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), and several trace elements such as Potassium, Sodium, Chloride, Lead, Arsenic, and Cadmium. These markers provide insights into various facets of water quality and necessitate comprehensive evaluations to ensure the well-being of communities reliant on boreholes.

Dissolved Oxygen (DO) is pivotal as it measures water's ability to support aquatic life and aerobic processes. DO measurements assist in determining ecosystem sustainability and identifying potential pollution levels.

Chemical Oxygen Demand (COD) reveals organic content, shedding light on water purity and susceptibility to pollution. Levels of Potassium, Sodium, and Chloride are vital for evaluating water salinity and its appropriateness for agricultural and human use.

The presence of toxic heavy metals like Lead, Arsenic, and Cadmium in borehole water raises significant concerns. Even trace amounts of Lead can cause developmental and cognitive impairments, while Arsenic and Cadmium are carcinogenic, posing substantial long-term health risks.

By utilizing advanced analytical methods and comprehensive testing, this research aims to provide a profound understanding of element distribution and concentration in borehole water. Through meticulous estimation and analysis, we can assess borehole water quality and make informed determinations about its suitability.

In conclusion, this article initiates a comprehensive exploration into estimating Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), and various trace elements in borehole water. The findings hold the potential to revolutionize water resource management, ensuring the safety, sustainability, and well-being of communities reliant on boreholes.

➤ *Aim*

To Estimate The Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Potassium, Sodium, Chloride, Lead, Cadmium and Arsenic in boreholes water in some Local Government Areas of Plateau State, Nigeria.

➤ *Specific Objectives*

- To Estimate the level of dissolved oxygen (DO) in boreholes water in some Local Government Areas of Plateau State, Nigeria.

- To Estimate the level of Chemical Oxygen Demand (COD) in boreholes water in some Local Government Areas of Plateau State, Nigeria.
- To Estimate the level of Potassium, Sodium and Chloride in boreholes water in some Local Government Areas of Plateau State, Nigeria.
- To Estimate the level of Lead, Cadmium and Arsenic in boreholes water in some Local Government Areas of Plateau State, Nigeria.

II. MATERIALS AND METHODS

Chemical Oxygen Demand (COD) was analyzed using Colorimetric method whereas Dissolved Oxygen (DO), Potassium, Sodium, Chloride, Lead, Cadmium and Arsenic were analyzed using Association of Official Analytical Chemists Manual (AOAC).

➤ *Statistical Analysis*

Statistical analysis was performed on statistical package for social science (SPSS) windows, version 20.0. Test of significance was determined using the student "t" test and the statistical significance was set at $P \leq 0.05$. The results were expressed as the Mean \pm SD.

➤ *Research Design*

The study samples comprised samples collected from Fifty (50) boreholes located in ten (10) local government areas of Plateau State.

➤ *Research Hypothesis*

• *Null Hypothesis (H0):*

There is no significant amount of Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Potassium, Sodium, Chloride, Lead, Cadmium and Arsenic in boreholes water in Plateau State, Nigeria.

• *Alternative Hypothesis (H1):*

There is significant amount of Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Potassium, Sodium, Chloride, Lead, Cadmium and Arsenic in boreholes water in Plateau State, Nigeria.

➤ *Laboratory Procedures*

(Association of Official Analytical Chemists, AOAC, 2019).

Dissolved Oxygen (DO) and Chemical Oxygen Demand (COD) were analysed using Titrimetric Methods.

Potassium, Sodium, Cadmium and Lead were analysed using Atomic Absorption Spectrophotometric Methods. Chloride was analysed using Mercuric Nitrates Method

III. RESULTS

Table 1. Showing Dissolved oxygen (DO), Chemical Oxygen Demand (COD) and Trace Metals (Mg/L). P≤0.05= Significant.

S/N	Parameters(mg/L)	Nigerian Industrial Standard(NIS) Requirements	1 Mean±SD	2 (mean±SD)	3 (mean±SD)	4 (mean±SD)	5 (mean±SD)	6 (mean±SD)	7 (mean±SD)	8 (mean±SD)	9 (mean±SD)	10 (mean±SD)	T-test	P-Values(P≤0.05)	Remarks	Test Methods
1	Dissolved Oxygen(DO)	—	7.60 ± 0.02	6.90 ± 0.01	6.00 ± 0.02	6.80 ± 0.02	9.02 ± 0.01	7.23 ± 0.02	6.03 ± 0.01	7.50 ± 0.02	6.49 ± 0.01	7.31 ± 0.03	1.232	0.034	Significant	AOAC-973.40
2	Chemical Oxygen Demand(COD)	—	15.68 ± 0.03	12.64 ± 0.02	13.92 ± 0.02	13.44 ± 0.01	15.20 ± 0.02	14.62 ± 0.03	12.72 ± 0.01	12.22 ± 0.02	13.70 ± 0.03	13.46 ± 0.02	0.346	0.045	Significant	Colorimetric
3	Potassium	—	4.724 ± 0.01	4.038 ± 0.00	7.314 ± 0.02	1.681 ± 0.01	4.210 ± 0.01	3.022 ± 0.02	1.341 ± 0.01	2.162 ± 0.02	6.121 ± 0.02	3.162 ± 0.01	2.213	0.000	Significant	AOAC-973.53
4	Sodium	200	27.73 ± 0.02	9.77 ± 0.01	24.98 ± 0.03	6.57 ± 0.01	20.21 ± 0.02	16.21 ± 0.02	19.32 ± 0.03	13.42 ± 0.02	6.63 ± 0.01	23.46 ± 0.03	1.423	0.026	Significant	AOAC-973.54
5	Chloride	250	15.59 ± 0.03	53.17 ± 0.02	47.50 ± 0.01	29.06 ± 0.01	40.21 ± 0.02	32.61 ± 0.01	16.63 ± 0.02	30.72 ± 0.01	25.82 ± 0.02	43.38 ± 0.03	1.623	0.000	Significant	AOAC-973.54
6	Lead	0.01	0.008 ± 0.01	0.012 ± 0.01	0.006 ± 0.02	0.000 ± 0.00	0.002 ± 0.01	0.013 ± 0.00	0.005 ± 0.02	0.007 ± 0.01	0.00 ± 0.00	0.008 ± 0.02	2.320	0.010	Significant	AOAC-974.27
7	Cadmium	0.003	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.000	0.000	Significant	AOAC-974.27
8	Arsenic	0.01	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.000	0.000	Significant	AOAC-920.205

IV. DISCUSSION

The results from Table 1 clearly shows that the Dissolved Oxygen (DO), Chemical Oxygen Demand(COD) and Potassium are not applicable to boreholes water since it is used for domestic purposes. for example, drinking, washing of clothes, bathing and for the preparation of dishes and not for aquatic life sustenance or industrial purposes, and as such the Nigeria Industrial Standard(NIS) do not have a standard reference ranges for these parameters.

However, comparing the values obtained from the analysis of the boreholes water, it is observed that the P- values were significant as P≤0.05. The values are extremely low compared to the NIS references ranges making the boreholes water well suited for domestic purposes.

V. CONCLUSION

The borehole water samples collected from various locations in Plateau State, Nigeria, are deemed safe and suitable for domestic use, as they exhibit no contaminations from the analyzed metals and heavy metals.

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