

A STUDY OF THE PHYSICO-CHEMICAL CHARACTERISTICS OF BOREHOLE WATER IN FEDERAL POLYTECHNIC ADO EKITI CAMPUS, SOUTHWESTERN NIGERIA

*Ayeni, O. O., & Sadiq, A.

^{1&2} Department of Civil Engineering, Federal Polytechnic, Ado – Ekiti Nigeria

*Corresponding author email: oladeleolusolaayeni.1@gmail.com

ABSTRACT

The study examined the physio-chemical characteristics of some selected ground water within the Federal Polytechnic, Ado Ekiti. Ten boreholes were selected due to their frequency and proximity to use by both students and staff of the institution and represented with codes A1 to A10. Each sample was taken directly from the borehole through the connecting riser pipes and stored in a 2ml sterilized PVC bottle, temperatures measurements of each the samples were taken immediately with Hanna portable thermometer, ice packed cooler were used to preserve the samples on site before onward transit to the Water/Public Health Laboratory of the institution where the samples were subjected to physico-chemical analyses. Water properties such as temperature, colour, odour, turbidity, pH, total alkalinity, chloride, iron, zinc chromium and manganese were investigated according to guidelines set by APHA 2005. Test results obtained from colour, odour turbidity, total alkalinity, chlorides, iron, Zinc of all the samples analyzed were found to be within the limit as set by the Nigerian Standard for Drinking Water Quality (NSDWQ). While chromium concentration in all the samples were above the permissible standard of 0.05mg/l except for the sample at location A10 which had no reading. Manganese concentration in 3 boreholes (A1, A4, and A8) were above the permissible limit of 0.2mg/l. It is recommended that the 10 boreholes should be subjected to both primary and secondary treatment before consumption.

KEYWORDS: Borehole; Groundwater; Physio-chemical; NSDWQ; Primary and secondary treatments

INTRODUCTION

Groundwater is vulnerable to contaminations (National Research Council, 1993). The importance of groundwater as an alternative source of water supply cannot be over-emphasized. It accounts for about 98 per cent of available freshwater (and about 0.76 per cent of all the water on Earth), the remaining 2 per cent being either surface water (i.e. streams and lakes) or distributed in the soil and atmosphere. Groundwater from boreholes are the main sources of water supply for domestic use in the Federal Polytechnic, Ado Ekiti. These water supplies are drawn directly from the boreholes without periodic check for its potability, it is pre-assumed that once it's a borehole, then it must be safe for consumption. Studies into groundwater

dynamics by many researchers such as Dada et al., (2011), Ndububa et al., (2017), Sanmi & Abbas (2017), Ibe et al., (2019) and Oyedele et al., (2019) have proved that groundwater sources are as susceptible to contamination as any other sources of water supply, reasons arising from factors such as the composition of soils and geologic materials in the unsaturated zone, the depth to the water table, the recharge rate, and environmental factors influencing the potential for biodegradation.

This research assisted in having an inside knowledge of water quality characteristics of groundwater samples been consumed within the polytechnic community. Also, the study is mindful of the origin of the natural composition of the groundwater which impact on its physical,

chemical and biological properties of the groundwater bodies. Noting that from the moment rain falls on the ground, infiltrates and pass through the soil and rock, the water dissolves the host materials in the process. Mineral salts are added to the water in the end. (Groundwater quality and contamination, 2004).

MATERIALS AND METHOD

Material

Study area

The Federal Polytechnic Ado Ekiti, is a Federal Government of Nigeria owned institution located in Ado Ekiti, Ekiti State of the Federation. The institution was established as a College of Technology in 1977 in Jos, Plateau State, moved in 1978 to Ondo State and status was changed to a full-fledged Polytechnic in 1979 before its final relocation to its permanent site in Ado Ekiti in Ekiti State in 1982. It has a population of over 10,000, comprising of Staff and Students (www.fedpolyado).

Methods

A total of Ten (10) boreholes were randomly sampled for to determine their physiochemical identities in the month of September 2019. These locations were chosen due to their proximity and frequency of use by both students and staff of the institution. Eleven (11) properties such as temperature, colour, odour, turbidity, pH, T. alkalinity, chloride, iron, zinc, chromium and manganese were analysed at the Water/Public Health Laboratory of the Department of Civil Engineering. The method adopted for the analysis was in conformity with APHA 2005, Standard methods for the determination of water and waste water D.C., American Public Health Association. Colour was determined using the colour comparator apparatus, odour through the use of the sensory cells after subjecting the sample to heat. pH values were obtained through

the use of Hanna portable digital meter, total alkalinity and chloride were determined by titration methods, while iron, zinc, chromium and manganese were determined through the use of DR 900 Colorimeter. The table below refers to the geographical locations and elevations of the Ten randomly selected borehole within the campus.

RESULTS AND DISCUSSION

Results of Physiochemical Analysis of Water Samples obtained from the Ten Boreholes within the campus

Properties of sampled water are shown in Tables 1 and 2 as well as Figures 2 to 10. Eight (8) boreholes A1, A2, A3, A4, A5, A6, A8 and A9 have temperature readings above the ambient (25°C) recommended by The Nigerian Standard for Drinking Water Quality (NSDWQ), while Two (2) boreholes, A7 and A10 were within limit. Figure 3, shows the colour values of water samples. All the samples have colour value of 5.0 H.U. The Nigerian Standard for Drinking Water Quality (NSDWQ), recommends that for groundwater water to be considered as potable the colour value must be within the permissible value ranged of 5 to 15 Hazen Unit. Hence, the colour values of all the water samples were within the permissible limit.

The Turbidity values of the water samples analyzed ranged from 0 to 5 NTU. NSDWQ recommends that for potable water, the higher the turbidity level the higher the risk of humans to develop gastrointestinal diseases. Hence the acceptable limit is 5 H.U.

pH is the degree of Acidity or the basicity of a sample and it ranged between 1 (acidity) to 14 (basicity). NSDQW recommends that the pH value of potable water should be within 6.5 (slightly acidic) and 8.5 (slightly alkaline). The water samples analyzed had their pH values

ranged between 5.95 (acidic) at location A10 to 7.59 (slightly alkaline) at A5. The chloride concentration in the water sample ranged from 28.36 to 127.62mg/l. All the samples have chloride concentration within the permissible level of 150mg/l as set by NSDWQ. The iron concentration in the water samples analyzed ranged from 0 to 0.3mg/l in conformity with the recommended standard set by NSDWQ. The Zinc concentration in the water samples analyzed ranged from 0 to 3mg/l in conformity with the recommended standard set by NSDWQ. The chromium concentration in the water sample ranged from 0 to 0.62mg/l. All the samples, except at location A10, had chromium concentration exceedingly above the recommended limit of 0.05mg/l. The chromium concentration in the water sample ranged from 0 to 5.5mg/l. Three samples in locations A2, A9 and A10 have manganese concentration within the permissible level of 0.05mg/l, while the rest exhibited concentration level beyond the permissible level as set by NSDWQ.

CONCLUSIONS

Temperature measurement in water samples are very important as it gives insight into the molecular activities as increase in temperature increases molecular interactions. The samples being obtained from groundwater and temperature measurement taken insitu, it's understandable that all the temperature values were a little above the ambient condition within except for a location. The colour, odour, turbidity, total alkalinity, chloride, iron and Zinc of all the samples are within the permissible condition recommended, which gave credence to the quality of the source. pH concentration. Sample A1, A2, A3, A7, A8, A9 and A10 displayed high level of Acidity beyond the permissible level, while samples at locations A4,

and A5 are within the permissible level of 6.5 to 8.5. Excessive ingestion of pH leads to diabetes, stomach problem and vomiting. Chromium concentration. All the samples analyzed displayed a high concentration of chromium above the limit specified except for sample at A10. Excessive ingestion of chromium leads to eye irritation, kidney damage, liver damage and respiratory cancer. Manganese concentration. Sample at locations A3, A4, A6, A7, A8 have concentration value beyond the permissible level of 0.05, while locations A2, A5, A9, A10 are within the permissible level. Excessive ingestion of manganese affects the central nervous system.

RECOMMENDATIONS

The physiochemical characteristics of the water samples obtained for analysis is in conformity with the dynamics of groundwater biochemical cycle. Erik Rominjn (2004) opined that weathering breaks up rock minerals and the released elements react with water and enter into solution as part of the biochemical cycle.

- i. The Samples exhibited high level of acidity, chromium and manganese. This can be associated with water dissolving host materials and minerals been added to the ground flow.
- ii. Its recommended that all the boreholes be treated before consumption. Reverse Osmosis method of treatment is preferable for its ability to adjust chemical constituent composition of water.

REFERENCES

- National Research Council. (1993). Ground water vulnerability assessment. *Predicting relative contamination potential under conditions of uncertainty*. Washington, DC, USA: The National Academies Press. <https://doi.org/10.17226/2050>
- Dada, T. E., Awokunmi, E. E., Falegan, C. R., & Olanipekun, E. O. (2011). Status of ground water quality in selected areas of Ado-Ekiti, Nigeria. *WIT Transactions on Ecology and the Environment*, 145,

- 339–348. <https://doi.org/10.2495/WRM110291>
- Ibe, P. I., Aigbedion, I. P., Marcellinus, M., Okoli, F. U., & Sola, A. B. (2019). Assessment of water quality Index for groundwater in Ado Ekiti, Nigeria. *World News of Natural Science*, 22, 93–101.
- Ndububa, O. I., & Adamolekun, O. S. (2017). Analysis of Access to Improved Water Supply for Domestic Use in Otunja Community, Ikole- Ekiti. *International Journal of Applied Environmental Sciences*, 12 (11), 1895–1912.
- Oyedeke, A. A., Ayodele, O. S., & Olabode, O. F. (2019). Groundwater quality assessment and characterization of shallow basement aquifers in parts of Ado - Ekiti metropolis, Southwestern Nigeria. *SN Applied Sciences*, 1(669), 1-13. <https://doi.org/10.1007/s42452-019-0683-1>
- Sanmi, A. M., & Abbas, B. (2017). Appraisal of Groundwater Quality in Ado-Ekiti Metropolitan Area, Nigeria. *International Journal of Advanced Engineering, Management and Science*, 3(2), 117–121. <https://doi.org/10.24001/ijaems.3.2.20>

Table 1. Summary table Showing Borehole Locations and representative codes

Parameters	Unit	Location										NSDWQ
		A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	A ₇	A ₈	A ₉	A ₁₀	
Temperature	°C	26.3	27.0	27.4	26.0	26.3	27.2	25.5	27.1	26.7	23.6	Ambient
Colour	H.U	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5-15
Odour	U	U	U	U	U	U	U	U	U	U	U	U
Turbidity	NTU	7.00	0.00	3.00	3.00	5.00	0.00	5.00	0.00	0.00	2.00	5.00
pH		6.16	6.24	6.05	7.23	7.59	6.59	6.19	6.04	6.38	5.98	6.5 -8.5
Total Alkalinity	Mg/l	85.4	48.8	61.0	97.6	97.6	73.2	61.00	85.4	122.0	61.0	250.00
Chloride Cl ⁻²	Mg/l	49.63	70.9	56.73	35.45	49.63	28.36	49.63	77.99	42.54	127.62	150.00
Iron	Mg/l	0.00	0.07	0.00	0.04	0.3	0.05	0.00	0.00	0.19	0.24	0.3
Zinc	Mg/l	0.20	0.04	0.03	0.00	3.00	0.05	0.00	0.00	0.14	0.00	3.00
Chromium	Mg/l	0.26	0.07	0.53	0.49	0.62	0.61	0.48	0.36	0.40	0.00	0.05
Manganese	Mg/l	0.30	0.00	0.2	0.60	0.02	0.20	0.2	5.50	0.00	0.00	0.2

Table 2. The summarized results of the physiochemical properties of water obtained from the randomly selected wells within the Polytechnic Campus.

S/N	Location	Code	Co-ordinate (UTM)		
			Easting	Northing	Elevation(m)
1.	Abuja Male Hostel	A ₁	754106	839401	375.9
2.	Annex Hostel	A ₂	752576	840751	379.6
3.	Schl of Business Studies (SBS)	A ₃	753719	839662	368.5
4.	DUDAP	A ₄	753214	839637	372.5
5.	Schl of Engineering (SOE)	A ₅	753718	839524	372.5
6.	Lagos Female Hostel	A ₆	752971	840232	373.6
7.	Mini-Mart	A ₇	753388	840481	368.4
8.	Old Administrative Building	A ₈	753192	839941	377.4
9.	Prime Guest House	A ₉	752470	839864	371.2
10.	Rector's Village (Staff Quarters)	A ₁₀	752323	839683	370.7

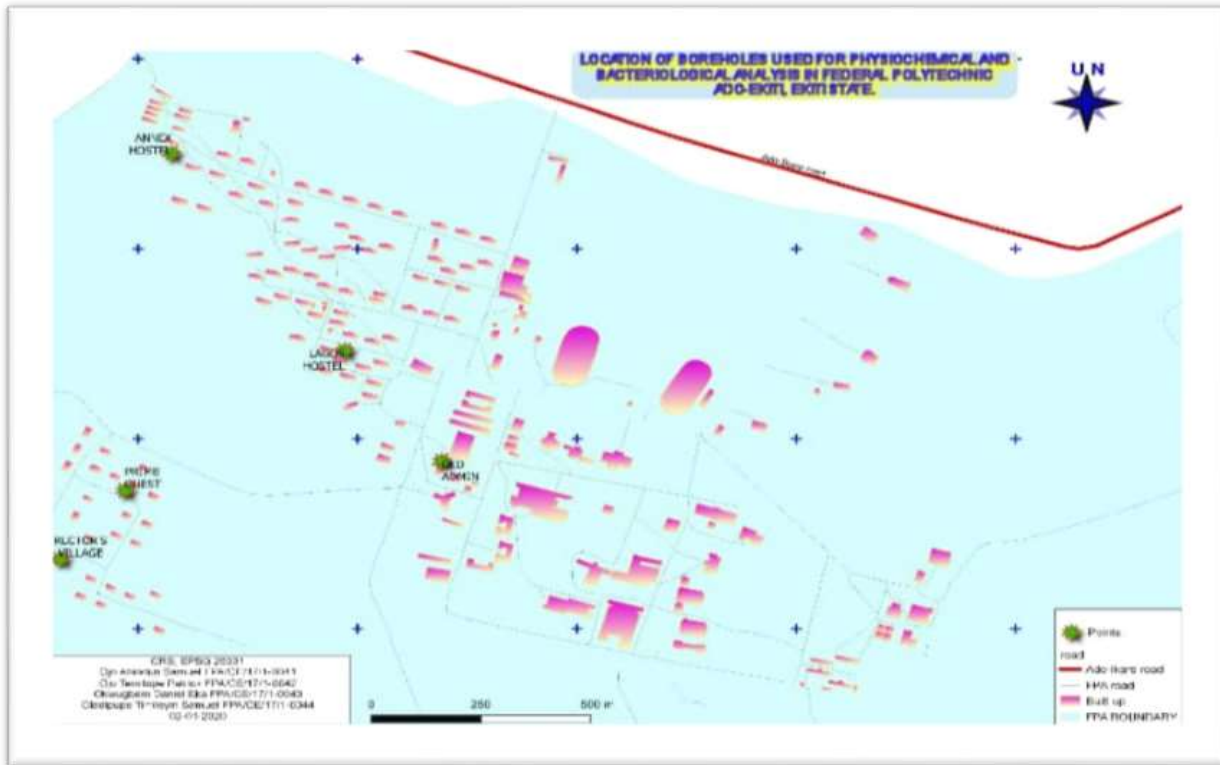


Figure 1: Map showing borehole locations in Federal Polytechnic, Ado Ekiti, Ekiti

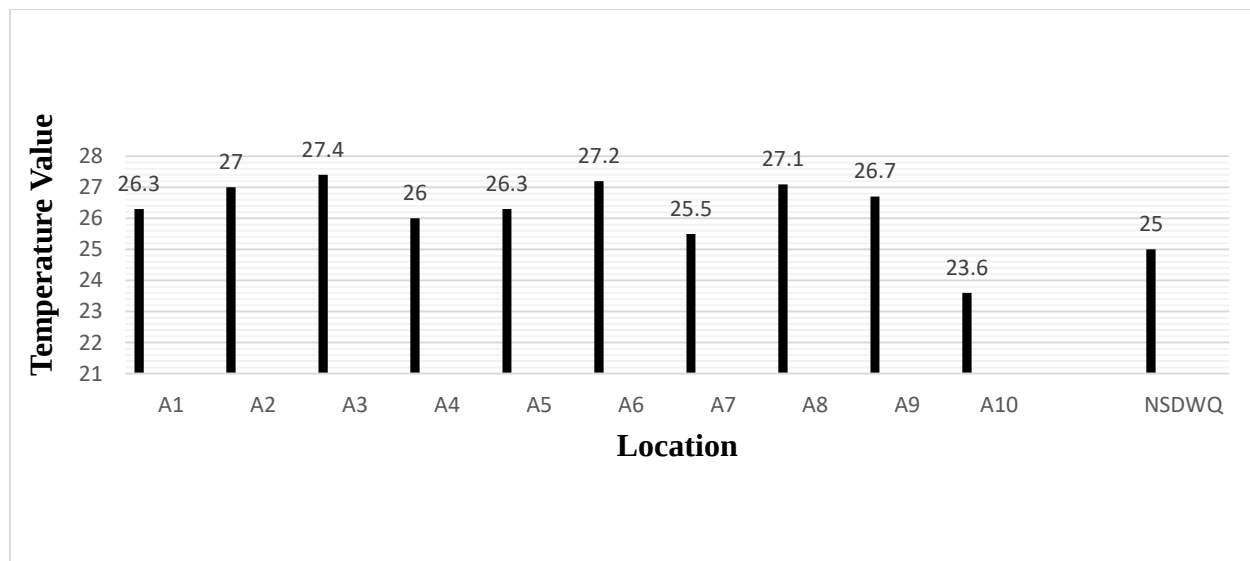


Figure 2. The temperature variations from the examined boreholes are from 23.6 to 27.4 °C .

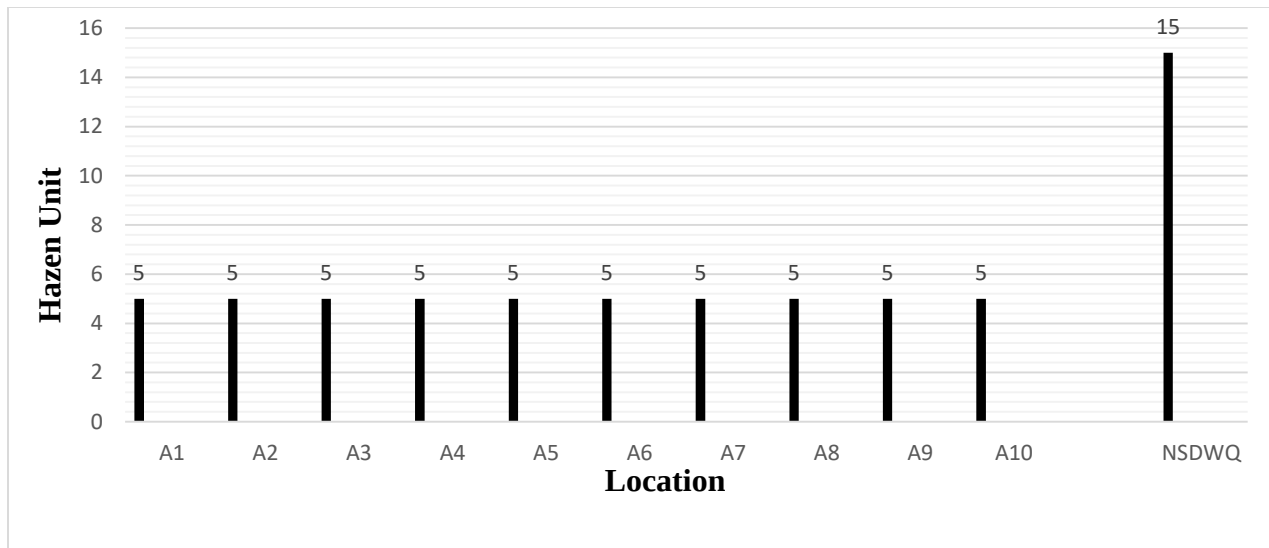


Figure 3. Colour Value of well water samples

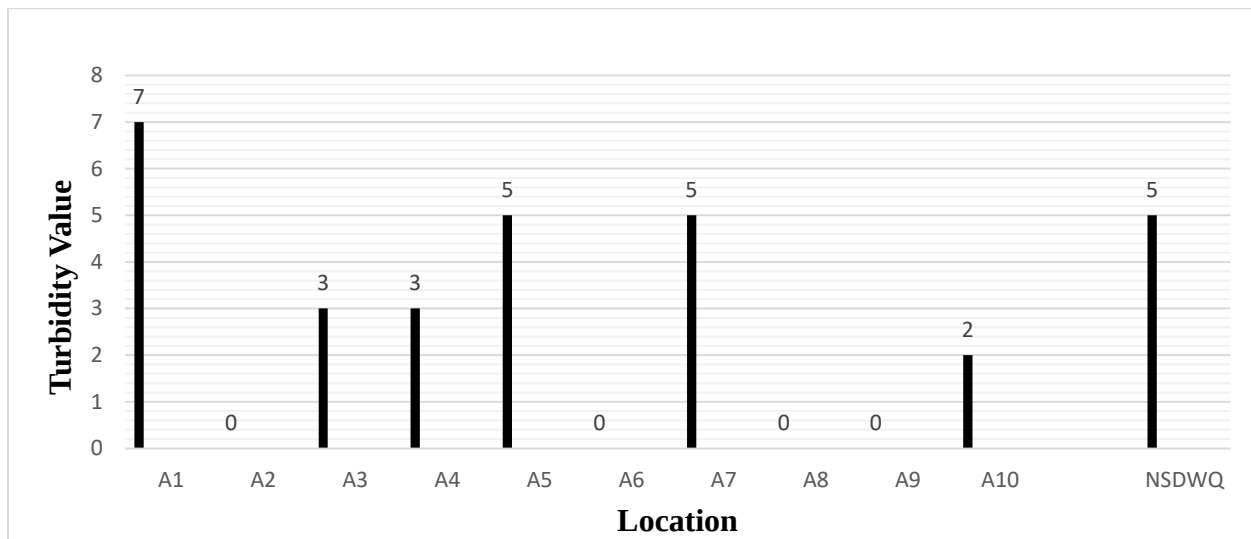


Figure 4. Turbidity Value of water sample

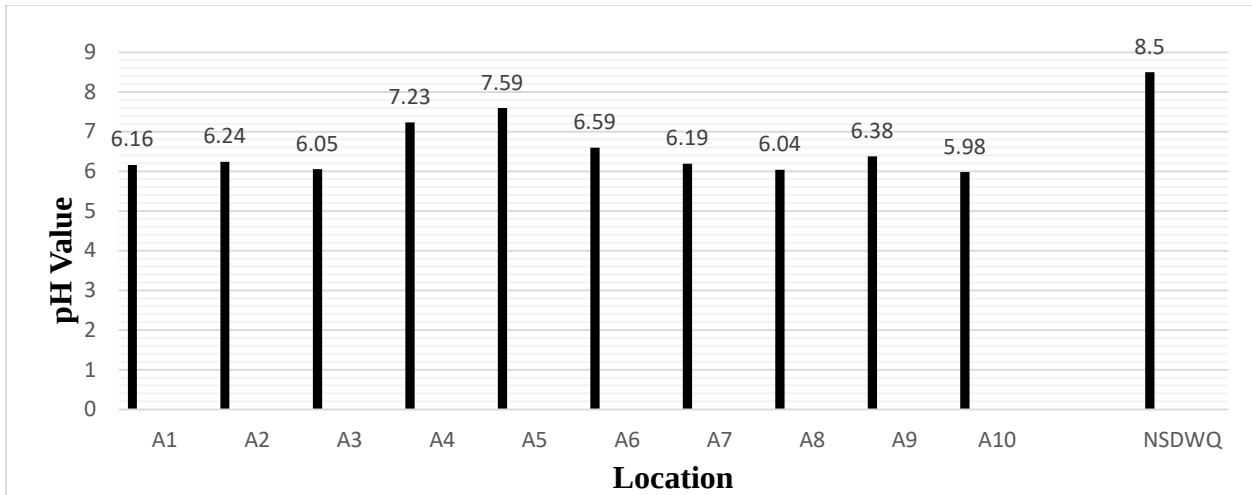


Figure 5. The pH value of water sample

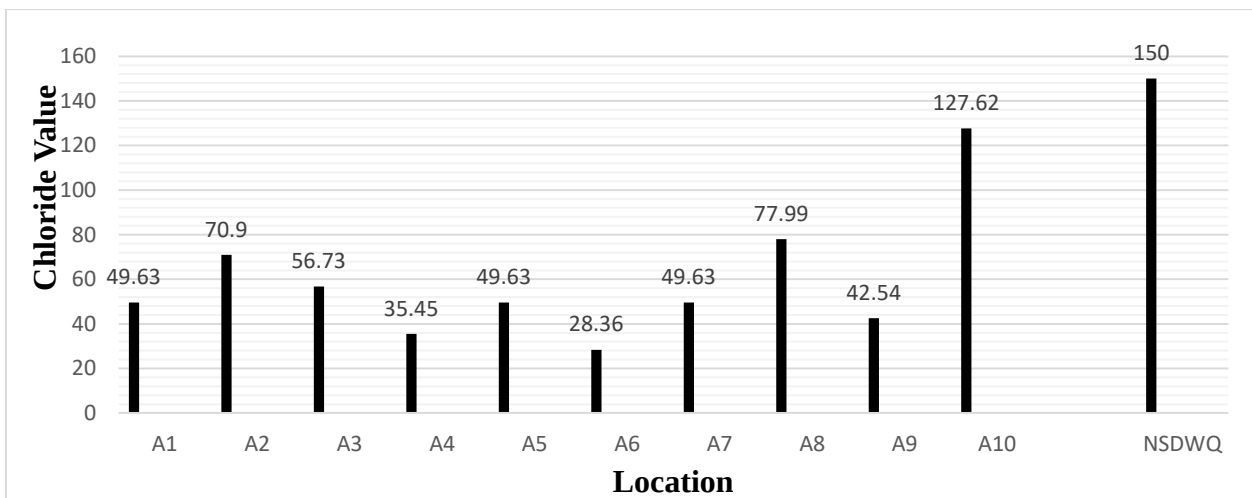


Figure 6. The Chloride value of water sample

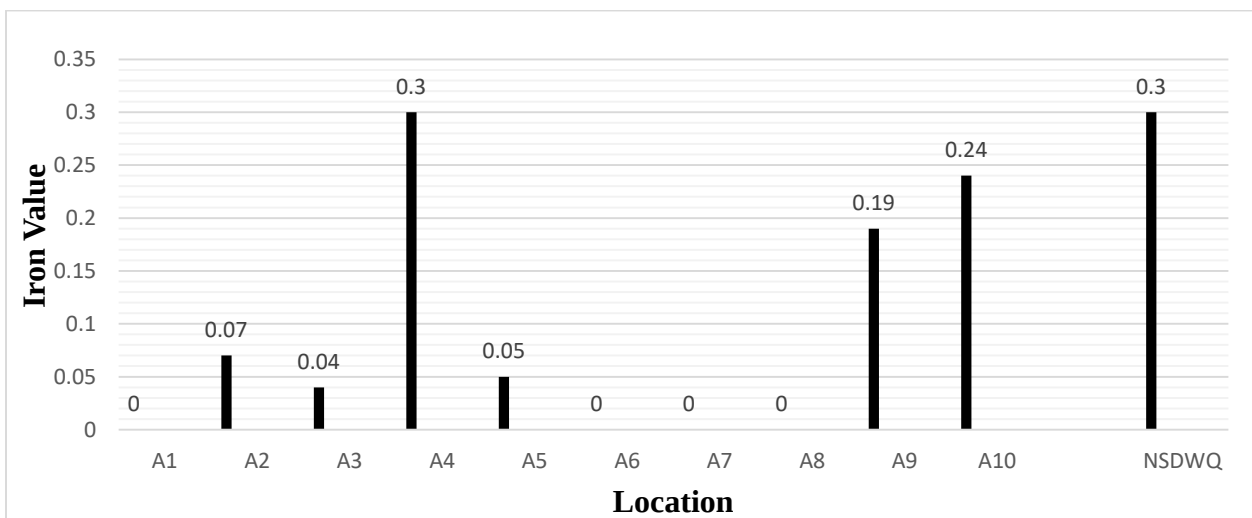


Figure 7. Iron concentration of water samples

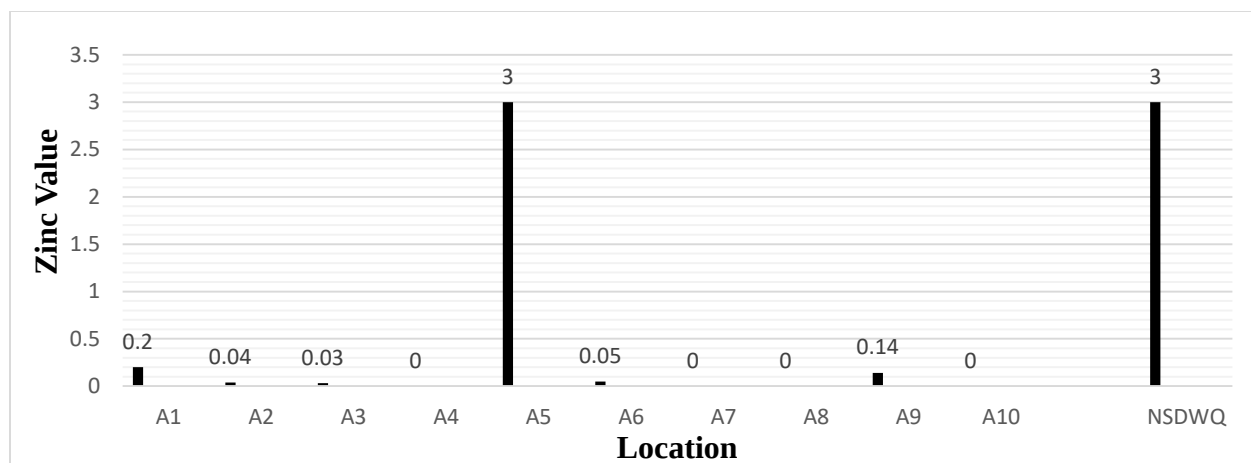


Figure 8. Zinc Concentration of the water sample

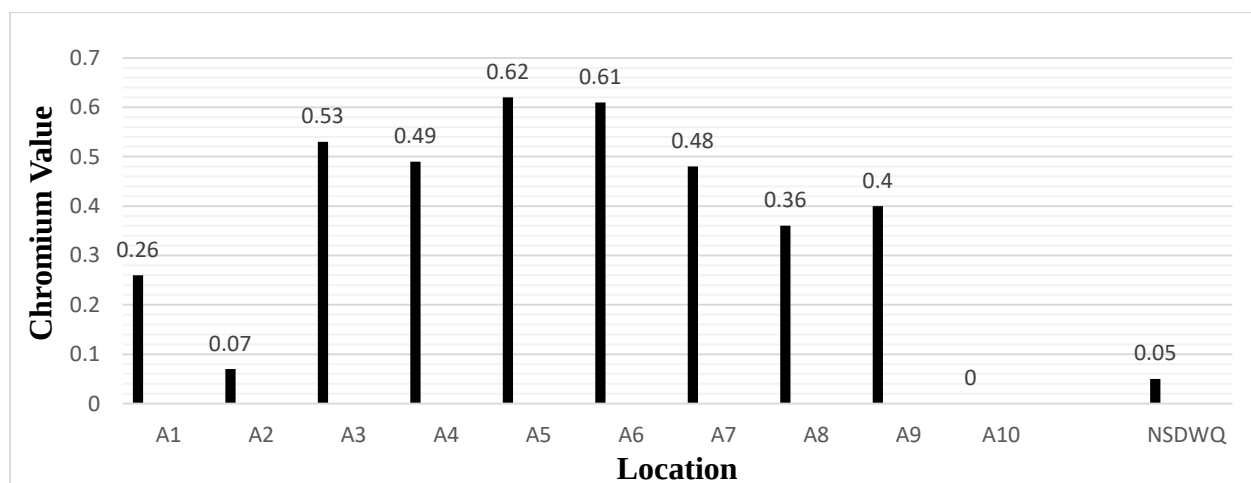


Figure 9. Chromium Concentration of the water sample

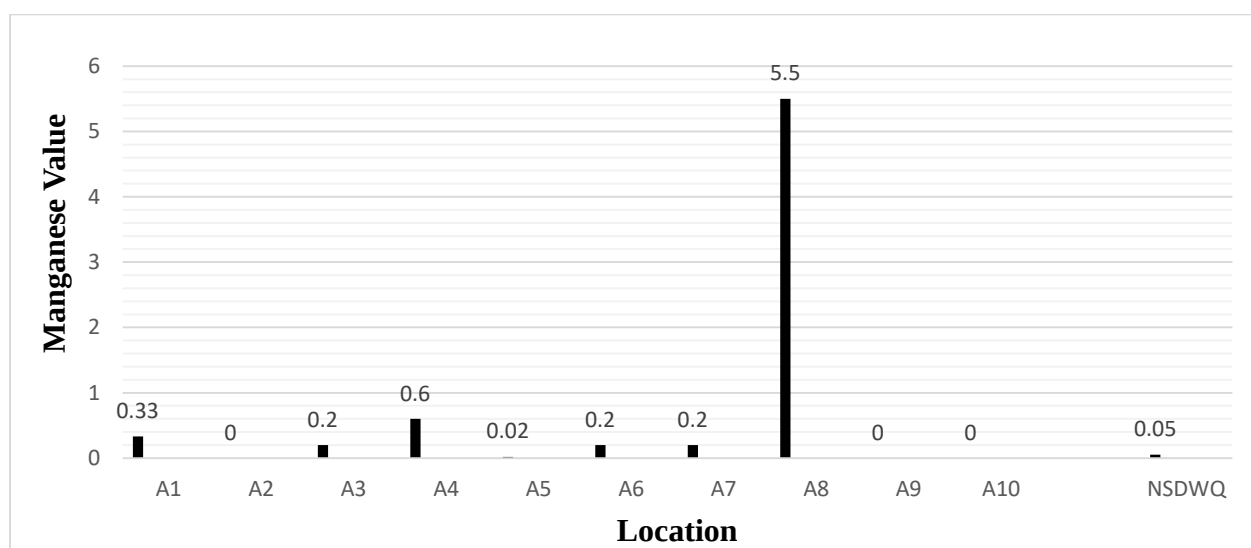


Figure 10. Manganese Concentration of the water sample