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Determination of Some Heavy Metals and Physicochemical Properties in Samples of Tube-Well Water in Evwreni Town, Delta State

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ABSTRACT

Ten samples of tube-well water were collected at random from Evwreni town, Delta State and were analyzed for heavy metals and physicochemical properties using atomic absorption spectrometer and standard methods respectively. The pH values were between 6.0 and 6.6, within the WHO maximum acceptable concentration. The conductivity values were between 66 to 99µs/cm, TDS value ranged from 60 to 85.5. The lead (Pb) ranged from 0.001 to 0.006mg/l, Copper (Cu) 0.2 to 0.9mg/l, iron (Fe) 0.3 to 0.7mg/l, Zinc (Zn) 0.1 to 0.3mg/l, Chromium (Cr) 0.1 to 0.5mg/l. All the values were below WHO maximum acceptable concentration.

Keywords : Physicochemical, Chromium, Copper, TDS, EDTA

I. INTRODUCTION

Drinking water is one of the most significance elementary needs for the survival of life span [1]. Throughout the entire world more than one billion people are faced with deficit of sufficient nontoxic water and among those more than 800 million in village areas are at threat for drinking water [2].

Water is the elixir of life and it is necessary for survival of all living things. Water makes up of more than one thirds of the weight of human body [3].

Man needs water for industrial development, navigation, irrigation to grow food, generation of hydro-electricity power, recreation and enhancement of fish, wildlife and host of other purposes [4].

Water resources have been the most exploited natural system since the world began and it is used for domestic, industrial and agricultural activities [5].

In Nigeria, especially in Niger Delta State area, tube-well serves as the most easily accessed and cheap source of drinking water for a greater number of 140 million people.

Water is the most important natural resources without which life would be nonexistent. Portable good water is already a limited source in many parts of our country and the whole world. Safe drinking water is a basic need for good health and it is also a basic right of humans.

Water posses the power of life and it is a constant auxiliary to our daily life, social organization, economic, ambition and function [6].

Heavy metals are those with a density range from above $3.0g/cm^3$ to $7g/cm^3$, atomic weight greater than sodium (23), atomic number greater than 20, found in period four (4) and above [7].

Nearly, all types of water contain heavy metals, many of which results from the natural wecdthermy of the surface of the earth [8].

In thousands of villages across the globe unsafe water from heavy metal contaminated is causing death and fatal diseases [9].

Water bodies are getting adulterated uninterruptedly with metals because of removal of solid waste and influenced by industries as well as domestic dirts [10].

The infants and younger populations are more prone to the toxic effects of heavy metals, as the rapidly developing body systems in the fetus. Infants and young children are far more sensitive [11]

II. MATERIAL AND METHODS

Location of the Research:

Evwreni Town is an Oil Producing Community in Ughelli North Local Government Area of Delta State. It has oil wells, glow and compressor status operated by the SPDC, which produces 15,000 barrels of crude daily from the area since 1996.

Evwreni is made up of six (6) major quarters: Urhevwe, Uruekpo, Uvwotie, Okpawha, Ogbudu and Uneni. There is no definite population census figure but it is one of the largest Community in Ughelli North Local Government Area. It is 154.6 kilometers by road to Port Harcourt and 45.3 kilometers to Warri.

Sample collection and analysis

Ten samples of 75ml of tube-well water were collected in clean plastic bottles from different quarters in Evwreni town. The samples were labeled from 1 to 10. Duplicate samples were collected and analyzed for physicochemical properties.

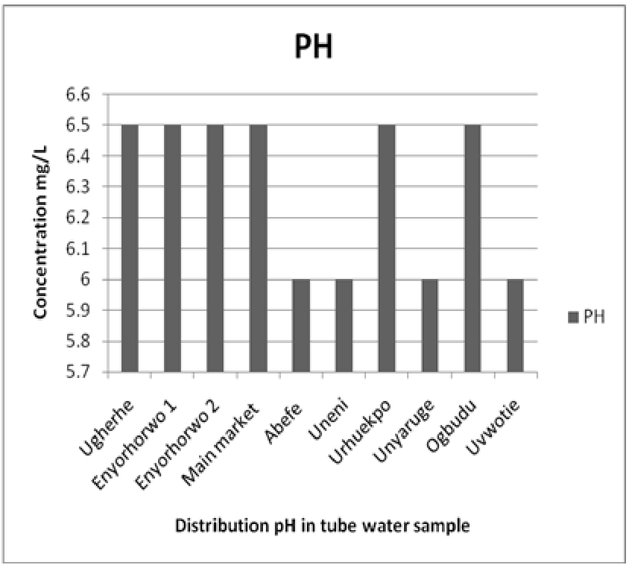
Physico-chemical analysis

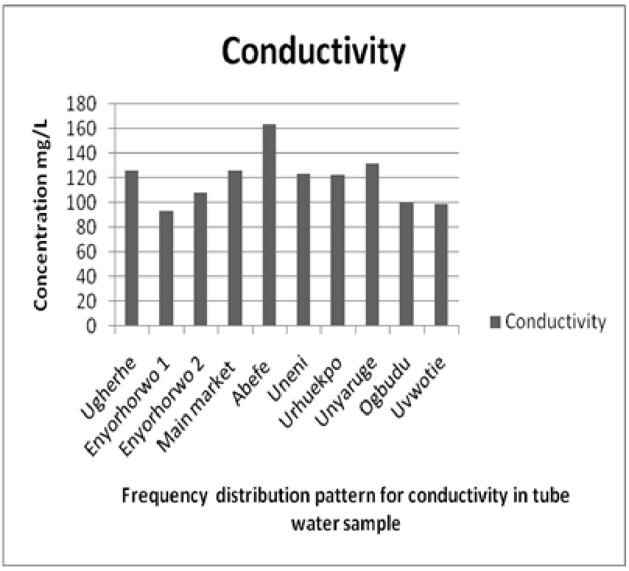
The appearance of water sample was analyzed and observed by virtual for colour and inhaled for odour. There was also physical determination for taste. The pH was determined using Jenway Model PH Water. The conductivity was determined with a conductivity meter (Aquopro Model AP - Z).

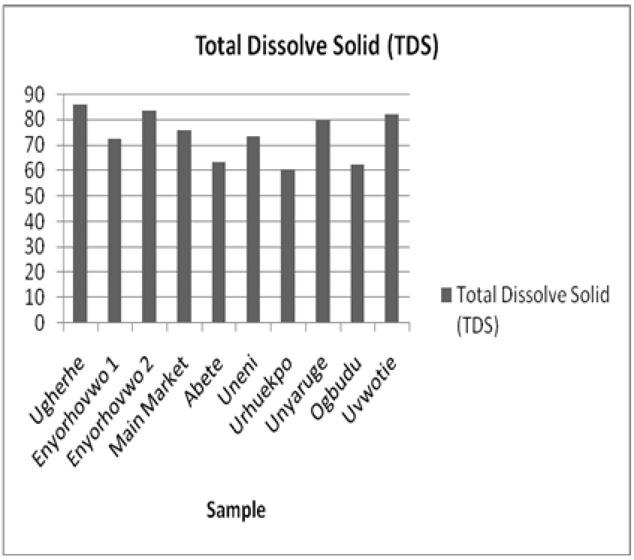
The total dissolved solid (TDS) by Gravimetric method, using conductivity/TDS meter. Total hardness, calcium and magnesium were determined by EDTA titrimetric method.

Table I : Physical properties of tube-well water samples

Sample	Appearance	Taste	Odour	pH	Conductivity	Total Dissolved Solid (TDS)	Total Hardness (TH)
1.	Colourless	Tasteless	Odourless	6.5	126	85.5±0.2	86.0±0.3
2.	Colourless	Tasteless	Odourless	6.5	94	72.1±03	91.3±0.9
3.	Colourless	Tasteless	Odourless	6.5	108	83.4±0.2	91.7±0.6
4.	Colourless	Tasteless	Odourless	6.5	126	75.7±0.1	66.0±0.2
5.	Colourless	Tasteless	Odourless	6.0	164	63.1±0.4	73.3±0.6
6.	Colourless	Tasteless	Odourless	6.0	124	73.2±0.4	101.3±0.6
7.	Colourless	Tasteless	Odourless	6.5	123	60.1±0.2	98.4±0.7
8.	Colourless	Tasteless	Odourless	6.0	132	79.5±0.4	99.3±0.9
9.	Colourless	Tasteless	Odourless	6.5	100	62.4±0.3	88.1±0.7
10.	Colourless	Tasteless	Odourless	6.0	99	82.1±0.2	91.3±0.9
(WHO)	Colourless	Tasteless	Odourless	6.5-9.6	900-μs/cm	100	500







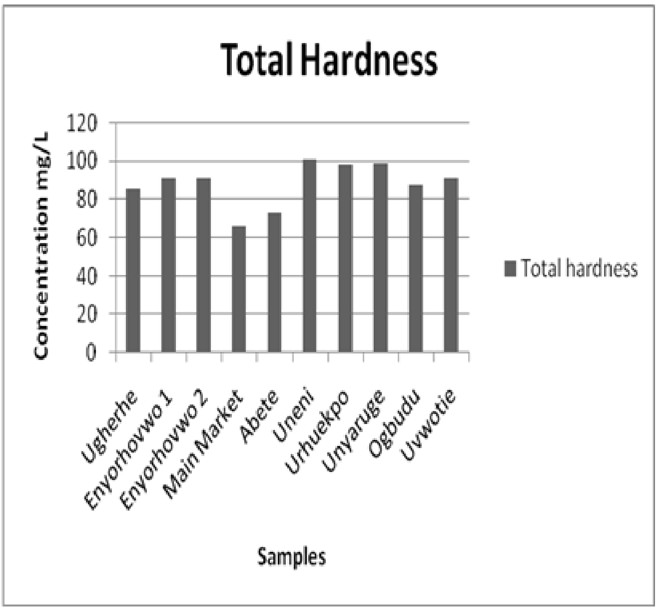


Fig 3. Frequency distribution pattern of total dissolved solid in tube-well water sample

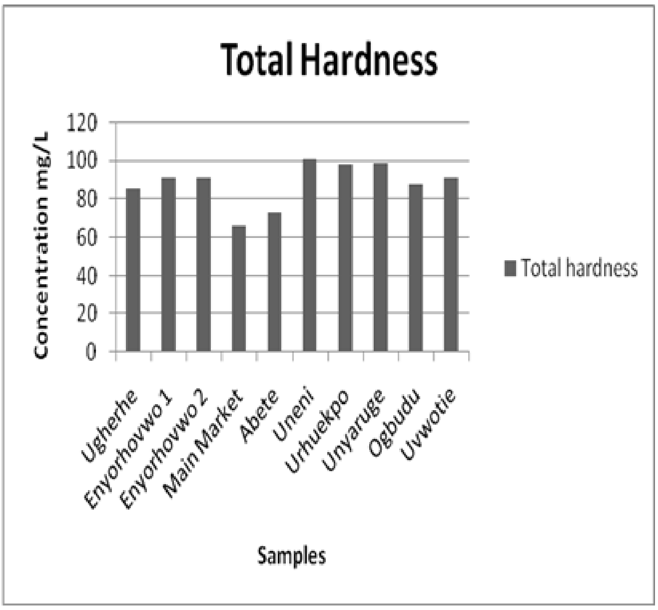


Fig 4. Frequency distribution pattern of total harness in tube-well water sample

III. RESULTS AND DISCUSSION

The samples (fig.2) of the tube-well water organoleptic assessment were carried out. All the samples were colourless, tasteless and odourless. The pH of the tube-well water ranged between 6.0 and 6.5 with WHO permissible limit (6.5-9.5), with the exception of samples 5, 6, 8 and 10 slight below with

6.0. The conductivity ranged from 94 to 164 μs/cm, with the permissible limit of WHO (900 μs/cm).

Heavy Metals in Water:

The samples were labeled from 1 to 10 and taken to the laboratory for the analysis of heavy metal.

The tube-well water samples were digested with nitric acid before further analysis for Pb, Cu, Zn and Cr.

The atomic absorption spectroscopy (model spectrum Lab ST-AAS-02, series AASW with Gravities finances, UK) instrument was used to detect the heavy metals.

Heavy metal concentrations of the tube-well were illustrated in Table (II) the metal concentrations in tube-well water were found in the following order: Pb>Cu>Fe>Zn in the ten tube-well water from Evwreni.

The sequence of metal concentration in the tube-well water sample was as follow: Pb>Cu>Fe>Zn (Table II)

PL: Permissible limit according to WHO [12]. The data shown are satisfactorily different at P<0.05 level. The difference in the concentration of the five heavy metals content of the tube-well water samples shows significance. The mean ± STD metals (Pb, Cu, Fe, Zn and Cr) were recorded for the tube-well water in Table II.

STATISTICAL ANALYSIS

SPSS (version 20) One-way ANOVA and Ducan multiple range test were used to evaluate the significance (P<0.05) in the concentration of different studied metals with respect to different sites.

A probability at the level of 0.05 less was considered significant. Mean ± STD was estimated.

Mean ± STD of heavy metals concentration (mg/l) in tube-well water.

Table II: Mean ± STD of Heavy Metals concentration (mg/l) in tube-well water.

	Heavy metals				
Well	**Pb**	**Cu**	**Fe**	**Zn**	**Cr**
1	0.006±0.2	0.5±0.0	0.5±0.0	0.3±0.2	0.01 ± 0.0
2	0.002±0.1	0.5±0.1	0.7±0.1	0.2±0.1	0.05 ± 0.1
3	0.001±0.0	0.5±0.0	0.5±0.2	0.2±0.1	0.02 ± 0.1
4	0.003±0.1	0.5±00	0.5±6.0	0.7±0.2	0.02 ± 0.2
5	0.005±0.1	0.4±00	0.3±0.1	0.3±0.1	0.02 ± 0.0
6	0.001±0.0	0.5±0.1	0.7±0.1	0.3±0.1	0.01 ± 0.0
7	0.002±0.1	0.5±0.1	0.7±0.1	0.2±0.1	0.02 ± 0.2
8	0.003±0.2	0.9±0.0	0.6±0.1	0.6±0.1	0.02 ± 0.0
9	0.001±0.2	0.5±0.0	0.5±0.0	0.3±0.2	0.03 ± 0.2
10	0.003±0.2	0.2±0.1	0.6±0.1	0.3±0.1	0.05 ± 0.1
PL(WHO)	0.01	2.00	3.00	3.00	0.05

On the physical properties, the appearance, taste, odour, pH and conductivity, (Table I) the samples of the tube-well water were colourless, tasteless and odourless, showing good value for consumption. The pH values obtained for six samples were 6.5 within, while four other samples were 6.0, slightly below WHO permissible limit (6.5 - 9.5). Low pH in water is a major course in some sensitive persons, of gastro-intestinal irritation.

The conductivity was between 94μs/cm and 132μs/cm, within the maximum permissible limits set by WHO (900μs/cm). The TDS levels found below the permissible limit set by WHO (100). The sample (1) has the highest (85.5 ± 0.2) while sample (7) has the least TDS level of (60.1 ± 0.2). But all the sample fall within the permissible limit recommended by WHO [12].

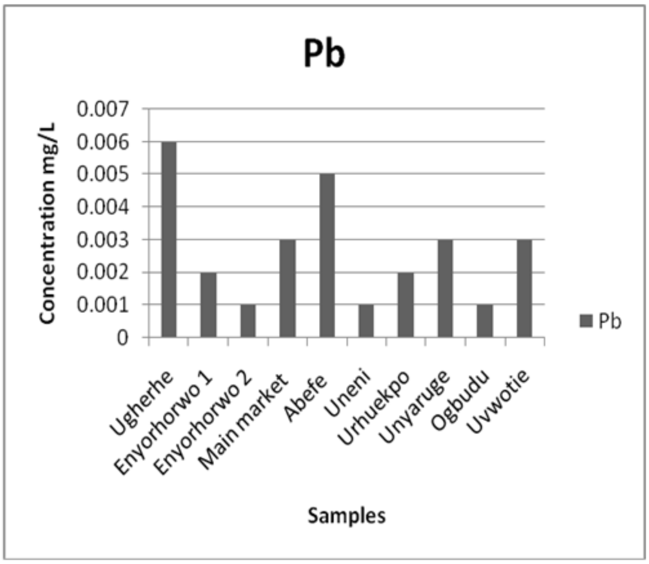


Fig 5. Frequency distribution pattern of lead in tube-well water sample

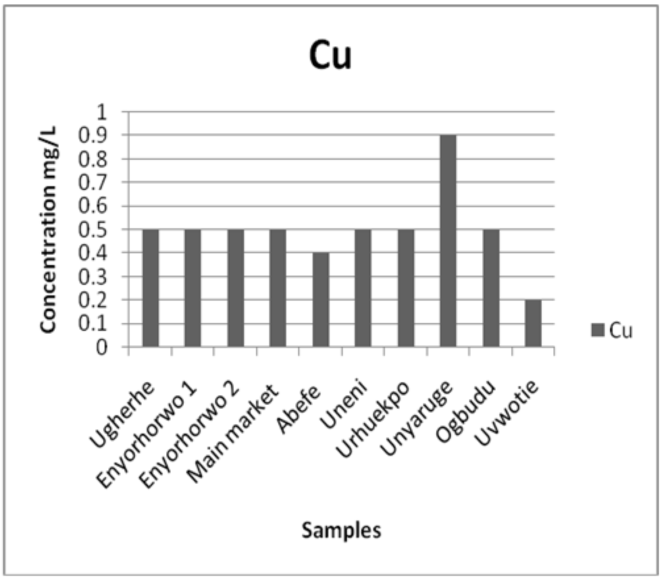


Fig 6. Frequency distribution pattern of iron in tube-well water sample

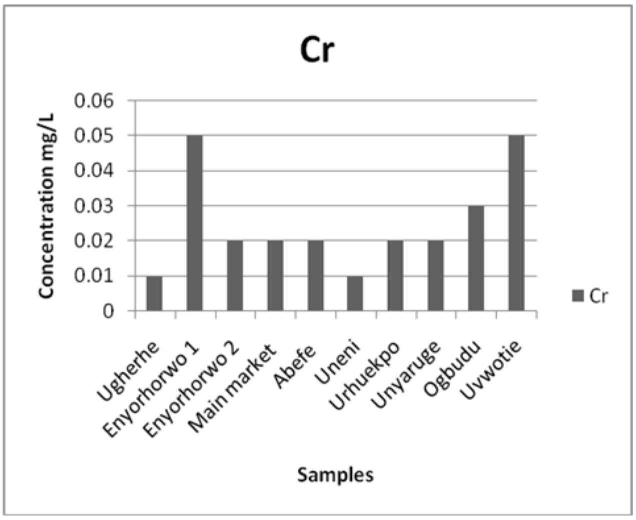


Fig 7. Frequency distribution pattern of chromium in tube-well water sample

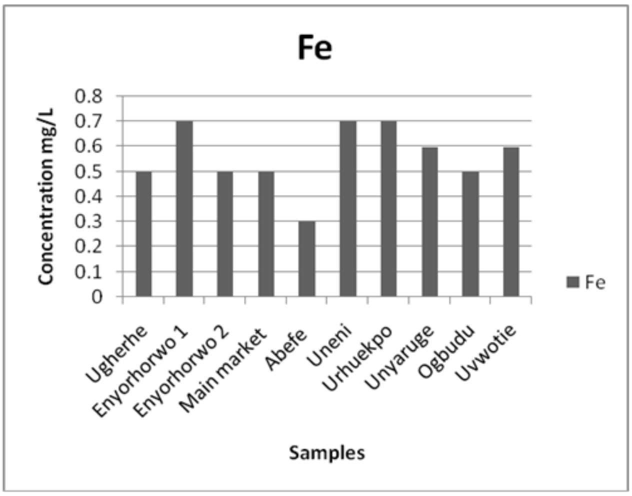


Fig 8. Frequency distribution pattern of iron in tube-well water sample

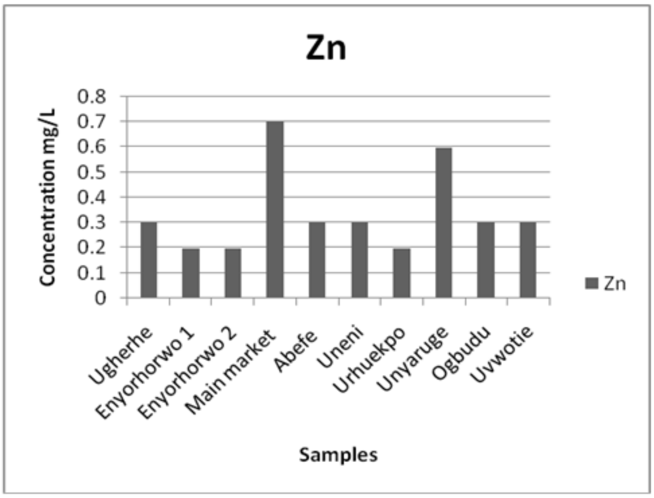


Fig 9. Frequency distribution pattern of zinc in tube-well water sample

Table II : Mean Concentration of heavy metal (mg/L) in tube-well water

	Water samples	Pb	Cu	Fe	Zn	Cr
1	Ugherhe	0.006±0.2	0.5±0.0	0.5±0.0	0.3±0.2	0.01±0.0
2	Enyorhovwo 1	0.005±0.1	0.3±0.1	0.6±0.1	0.3±0.1	0.05±0.1
3	Enyorhovwo 2	0.001±0.0	0.5±0.0	0.5±0.2	0.2±0.1	0.02±0.1
4	Main Market	0.001±0.0	0.5±0.1	0.7±0.1	0.3±0.1	0.02±0.2
5	Abete	0.005±0.1	0.4±0.0	0.3±0.1	0.3±0.1	0.02±0.0
6	Uneni	0.004±0.2	0.4±0.0	0.3±0.1	0.3±0.1	0.01±0.0
7	Urhuekpo	0.002±0.1	0.5±0.1	0.7±0.1	0.2±0.1	0.02±0.2
8	Unyaruge	0.03±0.1	0.9±0.0	0.6±0.0	0.6±0.1	0.04±0.0
9	Ogbudu	0.001±0.2	0.5±0.0	0.4±0.1	0.1±0.3	0.03±0.2
10	Uvwotie	0.003±0.2	0.3±0.1	0.6±0.1	0.3±0.1	0.05±0.1
	PL(WHO)	0.01	2.0	3.0	3.0	0.05

Ten samples of tube-well water were analyzed for Pb, Cu, Fe Zn and Cr with AAS. The Pb, Cu, Fe, Zn and Cr have maximum acceptable concentration of 0.01mg/l, 2.00mg/l, 3.00mg/l, 3.00mg/l and 0.05mg/l respectively for tube-well maximum acceptable concentration (M.A.C.). For the protection of human health guidelines for the presence of heavy metals in drinking water have been set by different international organizations such as WHO, EPA, USEPA and EUC [13].

The result, from (Table ii) shows that all the samples analyzed for the various heavy metals were within the safe limit recommended by WHO [12]. The mean + STD values of the measured metals (Pb, Cu, Fe, Zn and Cr) are as recorded.

The result obtained from the analysis of lead in (fig 3) is in the range of 0.001 to 0.006mg/l. The samples collection at both Enyorhovwo and main market have the concentration values of 0.001 mg/l while that of Ugherhe was with the highest concentration of 0.006mg/l; though lower than the WHO maximum acceptable concentration (0.01mg/l).

Lead is a potent neurotoxin that accumulates in soft tissues and bones and a possible human carcinogen [14]. It can cause damage to nervous connection (especially in young children) and brain disorder.

From the result of analysis of copper (fig. 4) it ranged from 0.20 to 0.90mg/L and all the concentration values for tube-well were below the WHO maximum concentration (2.00mg/L). Copper occurs in drinking water from copper pipe, as well as from additive designed to control algal growth [15]. Drinking water contaminated with high level of copper may lead to chronic enemia, vomiting, diarrhea, nausea and abdominal pain. Iron in (fig. 4) concentration in tube-well water sample ranged from 0.30 to 0.70mg/l and all the values were within the WHO maximum acceptable concentration (3.00mg/l). Iron mostly occurs in anaerobic underground water in the form of (ferrous) which is soluble and it becomes as an insoluble (ferric) when it comes in contact with air. The presence of Iron may be due to clay deposit in the area and is responsible for brownish-red colour of water when allowed to stay for some minutes. The presence of iron in water changes the characteristics of fresh water by altering the colour and as well as taste of water. From the result obtained for the analysis of zinc (fig 5), the values ranged from 0.1 to 0.3mg/L and all sample have concentration below the WHO maximum acceptable concentration fro drinking water (3.00mg/L). the chromium (fig 6) contents on the tube-well water analyzed ranged from 0.1 to 0.5mg/L.

The highest concentration of chromium recorded was 0.05mg/L, both at Enyorhovwo and Uvwotie and were exactly at the WHO maximum acceptable concentration (0.05mg/L). The boarderline chromium contents in these areas might be due to the presence of farm lands where different fertilizers are abundantly used in farming. Long term exposure to chromium can cause damage to the kidney, liver, circulatory and nervous tissues [15].

IV. CONCLUSION/RECOMMENDATIONS

The source of water (tube-well) studies is of the commonest sources of drinking water in Evwreni town. The physico-chemical properties investigated in this study were with the WHO permissible limits. The physical properties were all within the specified conditions. All the heavy metals analyzed were within the WHO maximum acceptable concentration (MAC). This shows that the tube-well water is fit for human consumption.

Nevertheless, the tube wells should not be sited at the outskirt of the town but far from farmland areas, in order to avoid high trace of chromium. The local government can also assist by assisting the community by carrying out a routine test for both organoleptic attributes and heavy metal concentration in the tube-well water.

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