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EVALUATION OF THE LEVEL OF HEAVY METALS IN UNDERGROUND WATER FROM CRUDE OIL POLLUTED AREA

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Abstract: **Evaluation of heavy metals in the environment is important for ensuring human and environmental health. Legislation sets limits on the maximum allowable concentrations of trace metals in the air, water, and food. The aim of this work is to evaluate the level of some heavy metals present in underground water within crude oil polluted site.Water samples were collected from Kegbara-Dere community in Gokana Local Government, they were analysed using the flame Atomic Absorption spectrophotometer method. The pH and total petroleum hydrocarbon were also determined. Result obtained showed Nickel in the polluted site varied from 0.073 – 1.39ppm, whereas in the unpolluted area, the value was 0.016ppm. Copper varied from 3.92 – 9.14ppm in the polluted site and had a value of 1.83ppm in the unpolluted site. Lead varied from 0.35 – 1.39ppm in polluted area and had a value of 0.003ppm in the unpolluted site. The amount of Zinc in the polluted area varied from 4.29 – 9.50ppm and had a value of 5.0ppm in the unpolluted area. The amount of heavy metals in the polluted and unpolluted area exceeded the recommended WHO stipulated limit of 0.001ppm for Lead and Nickel, though the unpolluted site had lesser concentration. The amount of Copper also exceeded 1.3ppm which is the recommended amount by EPA. This could be attributed to the heavy metals present in crude oil finding its way into ground water from crude oil pollution (polluted site)and high level of industrialization in the unpolluted site. Water samples should be properly treated to the WHO standard before consumption to ensure that the population is consuming a healthy portable drinking water.**

Keywords: **Heavy Metals, Evaluation, Crude Oil, Water, Polluted.**

1. INTRODUCTION

Water is an essential part of human nutrition, both directly as drinking (potable) water and indirectly as constituents of food (Thliza*et al*., 2015), and also in the pharmaceutical industries for the preparation of pharmaceutical products such as infusions, suspensions, injectable, etc. Water is one of the indispensable natural resources required for the continuous existence of all living things including man butwater pollution alters itspotability. Human activities such as industrialization and agricultural practices contributes immensely in no small measure to the degradation and pollution of the environment which adversely has an effect on the water bodies, one of such is oil spill (Owa, 2013). The major causes of oil spill in Nigeria are corrosion of pipelines and tankers (accounting for 50% of all oil spills), sabotage (28%) and oil operations (21%) with 1% of the spills being accounted for by inadequate or non-functional equipment (Nwilo*et al*, 2007). Many of the oil pipelines have been in place for over 30 years UNEP (2006) summed the impact of oil spillage in the Niger Delta as follows; high mortality of aquatic animals, impairment of human health,loss of biodiversity in breeding grounds, vegetation hazards, loss of potable and industrial water resources, reduction in fishing and farming activities, poverty and rural unemployment. Virtually every aspect of oil exploration and exploitation has deleterious effects on ecosystem stability and local biodiversity. Groundwater is a major source of water to many communities in Nigeria.Prolonged consumption of oil polluted water has adverse effect on the health of the consumers. Water with high level of hydrocarbon content may have negative effect on the kidney and liver of the consumers. Also poor reproductive system, leukemia, increased blood pressure and reduced blood clotting are associated with oil polluted water. It is important to note that groundwater pollution from oil spill is not always amenable to total clean up. It is therefore safer and wiser to prevent its occurrence.Increased level of industrialization and civilization of our urban areas has attracted an increase in the population density of our cities due to rural-urban migration. This has impacted significantly on the government for the provision and maintenance of basic social amenities required in society, quality water supply is one of such (Maduka*et al*., 2014; Mojekeh and Eze, 2011). As part of government strategy to make safe drinking water available to all, there came the establishment of the municipal and township water supply systems. Over the years, there has been a decline in the management of such facilities which has affected the quality of these water supply systems as a result of contamination through the delivery system arising from pipe leakages, poor water treatment, unpleasant taste of water, presence of flukes, etc. The demand for the provision of good quality water supply as an essential social amenity has led to the establishment of the table water industries, such as the sachet and bottled water in order to ensure its safety for drinking (Anyameneand Ojiagu2014; USEPA, 2012).It is estimated that about half of the patients occupying African hospital beds suffer from water-borne illnesses due to lack of access to clean water and sanitation (WHO/UNICEF, 2006).This holds true in Nigeria with some rural areas in the Niger delta in particular where most of the population live below poverty level and cannot afford to have potable water.

This study is was carried out to compare the level of some heavy metal present in underground water within crude oil polluted site in Rivers State in order to determine their safety and suitability for drinking.

2. MATERIALS AND METHODS

Sample Collection and Preparation

Water samples were collected from various boreholes within the Kegbara-Dere community using plastic bottles. The sample was transferred to the laboratory for physico-chemical analysis.

Sample Location

Five borehole water samples were obtained within Kegbara-Dere community in Gokana Local Government in River state, with a control sample taken far away from the community.Thearea was chosen because of the record of crude oil pollution of which crude oil from the oil spill would have found its way to ground water over time

pH Determination

The water samples of different brands were transferred into different beaker each, pH meter was immersed into the sample contained in a beaker and the reading was taken.

Test for heavy metals:

The apparatus and equipment used are Beaker, flasks, solar thermo elemental Atomic Absorption spectrophotometer (flameAAS) mode:S4=71096, Burner, Hollo Cathode lamps, Graphical display and recorder,pipets, Glassware, pressure-reducing value and volumemetricflask of suitable precision and accuracy. The reagents used are Air, Acetylene, Nitrogen dioxiode gas, metal free water, stock metal, Potassium chloride solution, Aluminium nitrate solution, Hydrogen tetraoxosulphate(vi) acid (H_2S0_4), Trioxonitrate(v)acid ($HN0_3$), Perchloric acid ($HCl0_4$). Using a wet digestion method, the total volume of 100ml of H_2S0_4, $HN0_3$, and $HCl0_4$ in the ratio of 40%:40%: 20% was mixed together, 10ml of each sample was weighed into different conical flask of each samples. They were digested in a fume cupboard with a hot plate until a white fume appeared. Sample were cooled and filtered into 100ml volumetric flask and the ml was mark with distilled water. Concentration was calculated and recorded by appropriate dilution factor**.**

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3. RESULTS AND DISCUSSION

Results obtained showed varying concentration of Pb, Ni, Cu, Zn, and Total petroleum hydrocarbon for the five different borehole water as shown below in table 1 and figure 1.

Table 1: Physico-chemical analysis result of the water samples obtained

Samples	pH	Pb (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	E.C (µS/cm)	TPH (ppm)
P1	5.89	0.85249	0.18724	5.28471	7.30621	125.38	12.51
P2	6.21	1.39113	0.31521	9.13604	4.29678	157.94	15.89
P3	6.87	0.34852	0.07319	3.92012	10.03126	98.52	9.27
P4	6.08	2.41736	1.38927	8.32627	5.01789	354.36	16.31
P5	6.79	1.18177	0.47463	6.29281	9.50393	187.04	21.07
P6 (Control)	6.94	0.03964	0.01671	1.83462	5.00584	150.92	3.27

Key:

Pb= Lead, Ni= Nickel, Cu= Copper, Zn= Zinc, E.C= Electrical Conductivity, TPH= Total Petroleum Hydrocarbon.

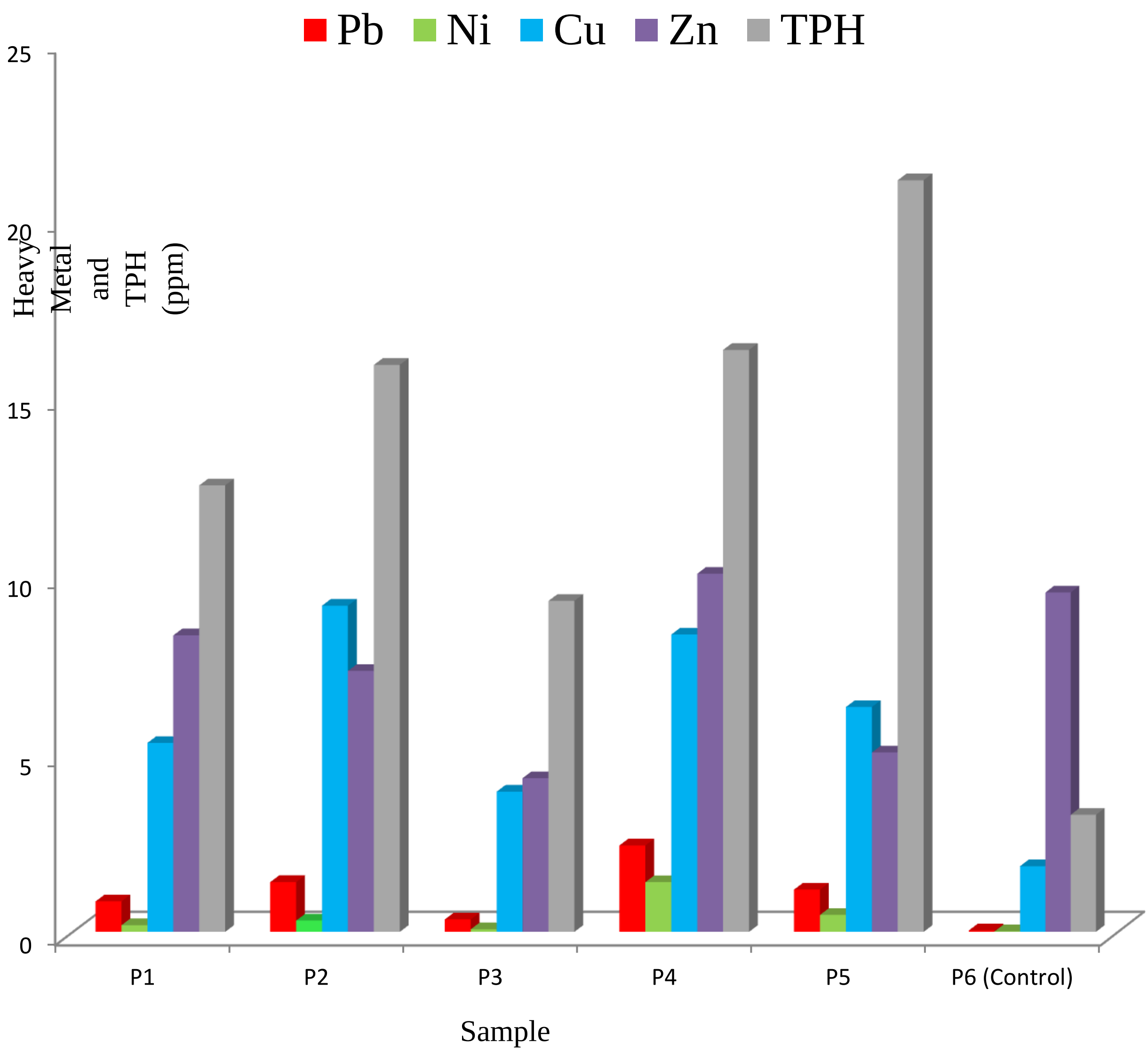

Figure 1: Bar chart showing the amount of Heavy metals and Total Petroleum Hydrocarbon in the samples of obtained.

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The TPH of water samples collected from the polluted site were higher than the unpolluted site ranging between 9.27 – 21.07ppm, showing peaks of stable hydrocarbons ranging from C8 – C20. TPH of water sample collected from the unpolluted site had a value of 3.27ppm, and showing peaks of stable hydrocarbons ranging from C8 – C20. This confirms the presence crude oil pollution in the area which would have found its way into ground water.

The pH of water samples analyzed in the study correlates with the findings of Aleru*et al.* (2020). From the data obtained, the pH of water samples collected from the polluted site was ranged between 5.89 – 6.87, and Point 1 having the highest acidity at with a value of 5.89. Point 3 was slightly acidic with a value of 6.87 compared to the limit of 6.5 – 8 for borehole water according to Most Permissible Limit (MPL) set by the Ethiopian limit, WHO and U.S EPA. (Shigut*et al.* 2017*)*. The value of the pH collected from the control area was 6.94, which meets the standard of The U.S Environmental Protection Agency (6.5 – 8). In the polluted area, acidity of the borehole water could pose a serious health risk to the population when they consume the water.

The conductivity of samples collected from the polluted area ranged between 98.52 – 187.04µS/cm, and sample from the unpolluted site was 150µS/cm. The range of conductivity of samples obtain did not exceed 400µS/cm which is WHO standard.

The presence of heavy metals in the polluted site correlates with Obiri (2007). From the water sample obtained, the amount of Nickel in the polluted site varied from 0.073 – 1.39ppm, whereas in the unpolluted area, the value was 0.016ppm. Copper varied from 3.92 – 9.14ppm in the polluted site and had a value of 1.83ppm in the unpolluted site. Lead varied from 0.35 – 1.39ppm in polluted area and had a value of 0.003ppm in the unpolluted site. The amount of Zinc in the polluted area varied from 4.29 – 9.50ppm and had a value of 5.0ppm in the unpolluted area. The amount of heavy metals in the polluted and unpolluted area exceeded the recommended WHO stipulated limit of 0.001ppm for Lead and Nickel and 3.0 for Zinc. The amount of Copper also exceeded 1.3ppm which is the recommended amount by EPA. This could be attributed to the heavy metals found present in crude oil finding its way into ground water from crude oil pollution, high level of industrializationand close proximity of the unpolluted site to the polluted area.

4. CONCLUSION

Heavy metals from crude oil pollution are able to make their way into underground water over time, and can bring about a high amount of heavy metals in the water sample. This is a contributing factor to the antibiotic resistance of bacteria isolated from the polluted area as constant and continuous exposure to these heavy metals induce antibiotics resistance. Infection by resistant strains of these organisms isolated could bring about infections that are difficult to treat, and can affect the wellbeing and economy of the population. Crude oil pollution should be properly cleaned to prevent crude oil making its way into ground water. Also, water samples should be properly treated to the WHO standard before consumption to ensure that the population is consuming a healthy portable drinking water.

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