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# Evaluation of Potentially Toxic Elements (PTE) From Mine Effluence Discharge (Case Study Of National Iron Ore Mining Company (NIOMCO), Itakpe, Kogi State – North Central, Nigeria.

Onsachi J, M[1], H. M Yakubu[2], Shaibu M. M[3]

*[1] Department of Mineral and Petroleum Resources Engineering, School of Engineering, P.M.B 1101 Kogi State Polytechnic, Lokoja.*
*[2] Department of Mineral and Petroleum Resources Engineering, School of Engineering, P.M.B 1101 Kogi State Polytechnic, Lokoja.*
*[3] Department of Mineral and Petroleum Resources Engineering, School of Engineering, P.M.B 1101 Kogi State Polytechnic, Lokoja.*
*Corresponding Author: Onsachi J, M*

**--------------------------------------------------------------ABSTRACT--------------------------------------------------------**
*Toxic elements are compounds that negatively affect people's health when they are in excess in the body system, but they becomes necessary to human's health and supportive to life when they are in small amount as recommended by World Health Organization standard i.e NIS554:2007. Some of the toxic elements analyzed during the project includes lead, arsenic, chromium Cobalt, Cadmium, Selenium, Beryllium Nickel etc. Two samples were taken from each location in National Iron Ore Mining Company (NIOMCO), Itakpe and one sample was acidified with concentrated nitric acid ($HNO_3$) while the other one was not acidified. We ensured that the rubber bottles were washed before taken each sample and the samples were all later sent to the Nigeria Agricultural Quarantine Service Laboratory Garki Centre Area Abuja for the analysis. The analysis was compared to the W. H. O standard for the physical and chemical parameters. These physical parameters are turbidity, temperature, conductivity, total dissolve solid, hardness and PH etc, while the chemical parameter are chloride sulphate, nitrate, Total alkalinity, magnesium, copper, iron, potassium e .t. c. while the Cobalt (Co), Cadmium (Cd), Selenium (Se), Beryllium (Be)and Gold (Au) were not detected. The result of the analysis showed that Manganes, Lead and Asenic are the potentially Toxic Elements that are associated with the Iron.*
***KEY WORD:*** *Mine, Effluence, Water, Quality, Standard*

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## I. INTRODUCTION

Toxic elements are heavy metals which can be found naturally in the earth, and become concentrated as a result of human activities. The most common sources of toxic element are mining and industrial waste. A toxic heavy metals or elements can now be defined as any relatively dense metal or metalloid that is noted for its potential toxicity, especial in environment contexts. The term has particular application to arsenic, lead, mercury and cadmium all of which appear in the world health organization list of ten (10) chemicals of major public concern. Other examples include manganese, chromium, cobalt, nickel, copper zinc, selenium, silver, antimony and thallium

The National Iron-Ore Mining Company at Itakpe, Kogi state has been one of the leading Iron-Ore Mining Companies in Nigeria during the last parts of 1980s and the first quarter of 20$^{th}$Century. Since Iron does not occur in isolation in nature it is found to be associated with other elements which can be toxic when discharged in water, these elements are Pb, Cr, As, Co, Zn, etc. There is the need to investigate the amount of its is discharge and the rate of its pollution to the surroundings especially in water and there for compare the result finding of the research with the W.H.O standard for good domestic water and industrial uses. The National iron-ore mining company at Itakpe is located at the down town of Eika and Ogaminana, along Lokoja Abuja express way in Adavi Local Government Area of Kogi State of Nigeria. It covers an area of about 7 x 6 $km^2$ with the geographical coordinate of longitude E 017$^0$14.566" to latitude N 08$^0$ 36.472 falling with geological survey of Nigeria 1:250,000 sheet 62 (geological survey of Nigeria 1986).

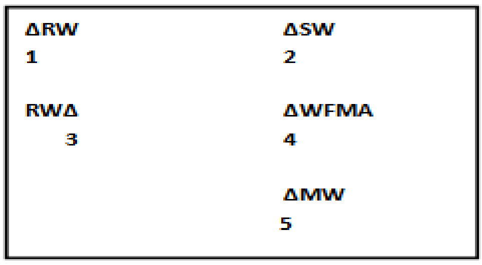


**Fig. 1:** Locational Map of the Samples from NIOMCO Itakpe

OM 300M

Rw: River water
Sw: Surface water
WFMA: Water from mine Area
MW: mine water
SSW: Stream sediment water
BRW: Benef River water

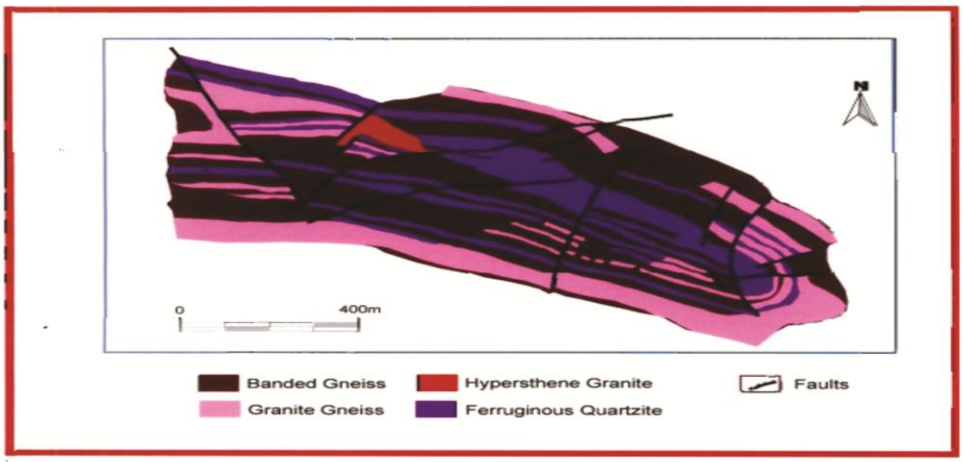


Fig 2.3 Geological Map of Itakpe Iron Ore Deposit (Modified from Akinrisola and Adekeye, 1993)

**Geology And Hydrogeology Of The Study Area**

The geologic setting of Itakpe area is that of two distinct complexes of rocks;

(a) Pre - Cambrian rocks which have undergone intensive tectonic and metamorphic changes and are commonly referred to as the basement complex and

(b) Mesocenozoic deposits only slightly affected by the process (N.S.D.A., 1976). The Nigerian basement complex is part of the Pan African mobile belt and lies within the West African Craton and South of the Tuareg Shield (Black 1980). The basement complex of Nigeria includes those of the North Central Nigeria, the Southwestern Nigeria and the Eastern province.

The three broad lithological groups within the Nigerian basement complex are the migmatite gneiss complex made up largely of migmatite and gneisses of various compositions, the low grade sediment dominated schist belt and the granitic rocks which cut both the migmatite gneiss complex and the schists belt (Ajibade and Woakes, in Kogbe 1980).

Geology of the Southwestern Basement Complex of Nigeria The study area is an extension of the basement complex of southwestern Nigeria characterized by schists that do not form well defined belts and are poorly exposed. The poor exposure is due to tropical climatic conditions and rainforest vegetation in the region. The basement complex of southwestern Nigeria is underlain by a generation of schists belonging to the migmatite gneiss complex sequence of probable Archean to early Proterozoic age and a generation belonging to the late Proterozoic age. A simplified geological map of Nigeria showing the schist belt and exposure of basement complex rocks (adapted from Kogbe, 1980)

**Hydrogeology Of Itakpe**

ltakpe belongs to the basement complex province of Nigeria, which includes the oldest rocks in Nigeria. Egboka (1986) in his unpublished paper on the hydrogeological provinces of Nigeria described the rocks of the basement complex provinces as having been variously weathered to form a mantle of residual soil. Also, series of fractures traverse the rock masses and the joints and faults have weathered zones. Groundwater occurrence is confined to shallow water table aquifers that are found in the weathered mantle, fractured and/or faulted traces. The weathered mantle is often too thin to trap good quantity of water during the rainy season and is very susceptible to water table lowering during the dry season. It is often too clayey to be of good permeability even though the porosity may be high.N.S.D.A. (1976) described the aquifers found within Itakpe. Developed within the boundaries of the deposit and in areas adjoining it, are fissures, water filled pores and fractures in the weathered crust as well as the fractures in un-weathered crystalline rocks. In the crust of weathering, the rocks have been weathered to various degrees and sometimes into sand and clay. The depth of weathering is between 9m - 54m. The weathering of rocks makes it very possible for atmospheric precipitation to infiltrate into the rocks. Depth to water table at Itakpe varies from 3.4m to 64.3m depending on the elevation of the ground surface at the point of measurement (N.S.D.A. 1976). The elevation of water table varies from 175m above mean sea level (a.m.s.1) to + 328.2m a.m.s.1. Geological records of boreholes and resistivity loggings carried out in some boreholes as well as results of well pumping tests, show that the depth of the zone of fracturing varies from 23.8m to 120.7m (NSDA.1976). Aquifer thickness varies from 13.4m to 72.5m. Discharge of water at some of the boreholes within Itakpe is about 3.6 **x** 10- m3/s. Temperature of water varies from 27'~ to 3 0 ' ~when atmospheric temperature is between 24'~and 29'~.The potentiality for groundwater occurrence in hard rock areas is influenced by the presence of lineaments. Presence of lineaments may act as a conduit for groundwater movement which results in increased secondary porosity and therefore, can serve as groundwater potential zone. According to Acharya and Nag (2005) stated that sustainable groundwater supply in basement area requires lineament analysis for proper sitting of boreholes. Generally, producing wells are located in areas of greater lineament density, lineament intersection, and degree of lineament connectivity. Lineament analysis has been used extensively for geologic interpretation, particularly since the 1930s with the advent of photo geology; besides satellite data provides quick and useful baseline information on the parameters controlling the occurrence and movement of groundwater like geology, lithology/structural, geomorphology, soils, land use/cover and lineaments. With the advent of remote sensing techniques, identification of the occurrence of groundwater has become a rapid and cost effective procedure. Lineaments that may act as conduits for fluid flow are of particular importance in this investigation.

**BENEFITS**: some elements otherwise regarded as toxic heavy metals are essential, in small quantities, according to WHO guidelines such as Zn = 0.01, Pb = 0.01, Cd = 0.003, Fe = 0.003 Mg = 0.50 Mn = 0.04Th = 0.002 Na = 0.002 Ni = 0.07 Cu = 2.0 etc for human health. These elements include vanadium manganese, iron, cobalt, zinc, selenium, strontium and molybdenum. A deficiency of these essential metals or elements may increase susceptibility to heavy metal poisoning.

**Detrimental Effects Of Some Toxic Elements**

| Element | Acute exposure usually as day or less | Chronic exposures often months or years |
|---|---|---|
| CADMIUM | Pneumonitis<br>(lung inflammatory) | lung cancer osteomalacia (softening ofbones)<br>proteinuria (excess protein in urine, possible kidney problem) |
| MERCURY | Diarrhea fever vomiting | Stomatitis (inflammation of gums and mouth) nausea<br>Nephrotic syndrome(nonspecific kidney disorder)<br>Neurasthenia( neurotic disorder)<br>Parageusia (metallic taste) pink disease (pain and pink discoloration of hands and feet)<br>Tremor. |
| LEAD | Encephalopathy<br>(brain dysfunction)<br>Nausea<br>Vomiting | Anemia<br>Encephalopathy<br>Foot drop /write drop(palsy)<br>Nephropathy (kidney disease) |
| CHROMIUM | Gastrintestinal<br>Hemorrhage (red blood cell distruction.<br>Acute renal failure | Pulmanary Fibrosis<br>(lung scarring)<br>Lung cancer |
| ARSENIC | Nausea<br>Vomiting<br>Diarrhea<br>Encephalopathy<br>Muli- organ effects arrhythmia<br>Painful neuropathy | Diabetes<br>Hypopigmentation/hyperkeratosis<br>Cancer. |

According to Nigeria industrial standard for drinking water NIS 554:2007 (S.ON).

The water quality standard ensures the safety of drinking water supply and the protection of public health from contamination effect of toxic element that commonly associated with water. Because of the higher degree of toxicity, arsenic cadmium, chromium, lead and mercury are ranked among the priority metals that are of public health significance.

These metallic elements are considered systematic toxicants that are known to induce multiple organ damage, even at lower level of exposure. They are also classified as human carcinogens (know or probable) according to the U.S. Environmental protection agency for research on cancer. This review provides production and use, potential for human exposure and molecular mechanisms of toxicity, genotoxicity and carcinogencity .Heavy metals are considered as trace elements because of their presence in trace concentrations (PPb range to less than 10ppm) in various environmental matrices.

Their bioavailability is influenced by physical factors such as temperature, phase association, adsorption and sequestration. It is also affected by chemical factors that influence speciation at thermodynamic equilibrium, complexation kinetics, lipid solubility and actual water partition coefficients. Biological factors such as species characteristics trophic interaction and biochemical/physiological adaptation, also play an important roles.

These essential heavy metals exerts biochemical and physiological functions in plants and animals. They are important constituents of several key enzymes and play important roles in various oxidation reduction reaction. The excessive exposure to copper has been linked to cellular damage leading to Wilson disease in humans similar to copper, several other essential element are required for biologic functioning, however, an excess amount of such metals produces cellular and tissue damage leading to a variety of adverse effects and human disease. For some including chromium and cupper, there is a very narrow range of concentrations between beneficial and toxic effects. Other metals such as Aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), Bismuth (Bi), cadmium (Cd), gallium (Ga), germanium (Ge), gold (Au), indium (In) Lead (Pb), lithium (Li), mercury (Hg), nickel (Ni), platinum (Pt), silver (Ag), strontium (Sr), tellurium (Te), Thallium (Ti) and uranium (U) have no established biological function and are considered non essential metals.

## II. MATERIALS AND METHOD

The method that was used to carry out this project work was random field sampling, sample and laboratory analysis. The materials that were employed for this work includes: sampling bag for carrying samples collected from different locations, Permanent marker for labeling sample. Field note book for recording sample collected from each location, robber bottle for collecting water sample from each location, global positioning system (G.P.S) for taking geographical co-ordinate of each sample locations, needle and syringe for extracting small portion of conc. $HNO_3$**,** concentrated nitric acid for acidity samples collected in each location**,** masking tape for labeling of each sample for easy identification.

It involved the collections of water samples at different locations from Niomco Ltd Itakpe Kogi State Nigeria. The samples were taken to the Nigeria Agricultural Quarantine Service Laboratory, Central Area Abuja for the analysis. The physical and chemical parameters were analysed and the results were evaluated and interpreted with the use of three types of modeling in operational researches iconic (physical) model, Analogue (Diagrammatical) model, and symbolic (mathematical) model. The statistical analysis evaluation and interpretation was also recorded. However, various geological maps such as map of the study area, contour map, locational map of the samples as well as the geological map of Nigeria showing the location of the minerals were shown in the project report. Furthermore, the pictures of the most ten (10) dangerous chemical elements was also reported

## III. RESULTS AND DISCUSSION

The result of the concentration of cation and anions including $Na^+$, $K^+$ $Ca^{2+}$, $Mg^{2+}$ $Cl^-$, $SO_4^{-2}$, $No_3^-$, $PO_4^-$ etc. and physical parameters in the water, such as temperature, turbidity, conductivity, total alkalinity, total dissolved solid, pH in surface and ground water are shown in tables 1, 2 , 3. 4, while the statistical analysis are shown in table 5.

**Table 1 Heavy Metals And Some Elements In Water Samples**

| HEAVY METALS AND ELEMENT PPM | SMAPLE LOCATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEMENTS | L1 | L2 | L3 | L4 | L5 | L6 | L7 | L8 |
| Zn | 1.24 | 3.00 | 4.15 | 2.00 | 3.95` | 3.93 | 2.98 | 0.91 |
| Pb | 2.45 | 5.55 | 1.24 | 4.90 | 5.90 | 1.00 | 6.00 | 3.90 |
| As | 3.90 | 1.00 | 2.99 | 3.80 | 2.82 | 1.12 | 5.1 | 0.09 |
| Co | nd | nd | nd | Nd | nd | Nd | nd | Nd |
| Cd | nd | nd | nd | Nd | nd | Nd | nd | Nd |
| Fe | 23.02 | 35.00 | 31.01 | 44.01 | 46.87 | 38.57 | 27.50 | 2.50 |
| Mg | 18.95 | 16.50 | 10.25 | 12.31 | 9.22 | 8.71 | 10.12 | 0.12 |
| Mn | 0.85 | 0.55 | 0.16 | 0.01 | 0.06 | 0.08 | 0.06 | 0.04 |
| Se | nd | nd | nd | Nd | nd | Nd | nd | Nd |
| Be | nd | nd | nd | Nd | nd | Nd | nd | Nd |
| K | 0.10 | 0.01 | 0.11 | 0.02 | 0.03 | 0.06 | 0.04 | 0.02 |
| Th | nd | nd | nd | Nd | nd | Nd | nd | Nd |
| Na | 0.01 | 0.25 | 0.12 | 0.08 | 0.01 | 0.04 | 0.01 | 0.91 |
| Ni | 0.10 | 0.20 | 0.11 | 0.08 | 0.51 | 0.01 | 0.01 | 0.01 |
| Cu | 0.96 | 0.856 | 0.23 | 0.72 | 0.85 | 0.75 | 0.25 | 0.26 |
| Au | nd | nd | nd | Nd | nd | Nd | nd | Nd |

**Note**: nd = not detected PPM= Parts per million or mg/l

**Tale 2 Physical, Chemical And Biological Elements At Various Locations.**

| PARAMETERS | SAMPLE LOCATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PHYSICAL | L2 | L2 | L3 | L4 | L5 | L6 | L7 | L8 | Units |
| Temperature | 28.01 | 29.01 | 20.15 | 23.11 | 29.99 | 31.07 | 27.11 | 28.92 | $^0$C |
| Turbidity | ).02 | ).05 | ).01 | ).67 | ).99 | ).90 | ).76 | ).86 | NTU |
| Electrical conductivity | 12.15 | ).95 | ).95 | ).93 | 3.59 | ).09 | ).00 | 11.00 | M Simen@25 $^0$C |
| Total dissolve solids | 76.02 | 32.00 | )2.05 | 36.88 | 76.12 | 78.14 | 36.12 | 39.17 | Mg/l |
| Acidity | 3.00 | 2.05 | 1.09 | 1.00 | 2.00 | 1.00 | 1.01 | 1.41 | Mg/l |
| PH | 7.50 | 5.99 | 7.99 | 5.99 | 3.00 | 7.90 | 7.03 | 7.53 | Units |
| **CHEMICAL PARAMETER** | | | | | | | | | |
| Total Alkalinity | 57.00 | 32.01 | 58.95 | 47.01 | 43.00 | 33.00 | 33.00 | 31.41 | Mg/l |
| Total hardness as Caco$_3$ | 36.04 | 32.00 | 28.08 | 22.92 | 14.34 | 16.15 | 12.94 | 14.00 | Mg/l |
| Salinity | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| **ANIONS** | | | | | | | | | |
| Chloride ($Cl^-$) | ).02 | 1.98 | ).25 | 2.12 | ).02 | ).98 | ).05 | 5.35 | Mg/l |
| Sulphate($SO_4^-$) | 4.04 | 3.00 | 3.05 | 22.05 | 23.05 | 3.12 | 23.05 | 5.02 | Mg/l |
| Phosphate ($PO_4^-$) | 3.33 | 3.20 | 2.11 | 4.00 | 2.95 | ).33 | 3.93 | 4.23 | Mg/l |
| Nitrate ($NO_3^-$) | 5.00 | 7.00 | 5.52 | 5.52 | 4.25 | 5.00 | 4.90 | 4.01 | Mg/l |
| **CATION** | | | | | | | | | |
| Calcium ($Ca^+$) | 28.07 | 32.10 | 12.95 | 16.11 | 13.12 | 11.67 | ).09 | 10.07 | Mg/l |
| Sodium ($Na^+$) | 11.99 | 3.55 | 10.55 | 3.99 | 5.05 | 5.98 | 2.97 | 3.79 | Mg/l |
| Copper ($Cu^+$) | ).02 | ).99 | 2.30 | ).07 | ).95 | ).32 | ).30 | ).25 | Mg/l |
| **MICROBIAL ANALYSIS** | | | | | | | | | |
| Total coliform bacterial | 5.03 | 3.05 | 2.06 | 1.95 | 3.15 | 5.17 | 4.00 | 5.00 | Cfu/ml |
| BOD | 3.05 | 2.06 | 3.15 | 2.93 | 3.00 | 2.90 | 2.05 | 3.00 | Mg/l |
| D. Oxygen | ).90 | ).81 | ).85 | ).85 | ).75 | ).25 | ).35 | ).36 | Mg/l |
| Carbondioxide | 1.02 | 3.25 | 1.00 | 2.00 | 2.00 | 1.00 | 1.00 | 1.03 | |

**Note:** nd = not detected
PPM = Parts per million or mg/l, NTU = Nephelometric Turbidity Units (combine average filter effluence), $^O$C = Degrees Celsius, mg/l = Milligrams per liter (equals parts per million) µg/l = Micorgrams per liter (equals parts per billion), Cfu/ml = colony forming units per milliliters.

**Table3 World Health Organisation Standard For Drinking Water (Who Standard)**

| METALS NAME | USEPA (Maximum contaminant level) | WHO Guideline value | B15: 10500 (Permissible Limits) | Units |
|---|---|---|---|---|
| Zinc (Zn) | 5.0 | Nm | 15.0 | ppm or mg/l |
| Lead (Pb) | 0.015 | 0.01 | 0.01 | ppm or mg/l |
| Arsenic (AS) | 0.01 | 0.01 | 0.05 | ppm or mg/l |
| Cobalt (Co) | - | - | - | ppm or mg/l |
| Cadmium (Cd) | 0.005 | 0.003 | 0.003 | ppm or mg/l |
| Iron (Fe) | 0.300 | 0.300 | 0.100 | ppm or mg/l |
| Magnesium (Mg) | 0.50 | 0.50 | 0-.50 | ppm or mg/l |
| Manganes (Mn) | 0.05 | Nm | 0.3 | ppm or mg/l |
| Sellenuim (Se) | 0.05 | 0.04 | 0.01 | ppm or mg/l |
| Berillum (Be) | 0.004 | 0.003 | 0.001 | ppm or mg/l |
| Potassium ( K) | - | - | - | ppm or mg/l |
| Thallium | 0.0005 | 0.002 | 0.002 | ppm or mg/l |
| Sodium (Na) | 0.02 | 0.002 | 0.02 | ppm or mg/l |
| Nickel (Ni) | - | 0.07 | 0.02 | ppm or mg/l |
| Copper (Cu) | 1.3 | 2.0 | 1.5 | ppm or mg/l |
| Gold | - | Nm | - | ppm or mg/l |

**Table 4 Statistical Analysis Of The Result**

| S/N | Physical chemical and biological parameters | Number of smaples | Maximum values | Minimum value | Range | Sum $(\sum x)$ | Mean $X = \frac{\sum fx}{n}$ | Variance $\partial^2 = \frac{(x-\bar{x})}{n-1}$ | Standard deviation $(\partial)$ | WHO Standard | Unit – |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | 8 | 31.01 | 20.15 | 10.95 | 14.31 | 26.78 | 12.36 | 3.51 | 22-30 | °C |
| 2 | PH | 8 | 8.00 | 6.99 | 1.31 | 59.93 | 7.49 | 10.30 | 3.28 | 6.8-8.5 | |
| 3 | Turbidity | 8 | 0.99 | 0.01 | 0.89 | 4.26 | 0.53 | 1.2899 | 1.1357 | 500 | NTU |
| 4 | E.Conductivity | 8 | 12.15 | 8.59 | 3.56 | 79.66 | 9.95 | 1.348 | 1.161 | $1.500\times10^{6}$ | M Simen |
| 5 | Total dissolve solid TDS | 8 | 92.05 | 76.02 | 16.03 | 666.5 | 83.31 | 37.80 | 6.148 | 1000 | Mg/l |
| 6 | Acidity | 8 | 3.00 | 1.00 | 2.00 | 12.56 | 1,57 | 0.527 | 0.725 | 5 | - |
| 7 | Total hardness as $CaCo_3$ | 8 | 36.04 | 12.94 | 23.10 | 176.47 | 22.05 | 81.987 | 9.055 | 400 | Mg/l |
| 8 | Chloride | 8 | 5.53 | 0.02 | 5.51 | 10.77 | 1.34 | 3.366 | 1.834 | 250 | Mg/l |
| 9 | Nitrate | 8 | 7.00 | 4.01 | 2.99 | 42.20 | 5.27 | 1.0756 | 1.0371 | 5 | Mg/l |
| 10 | Sulphate | 8 | 23.05 | 4.04 | 19.01 | 97.38 | 12.17 | 79.87 | 8.937 | 200 | Mg/l |
| 11 | Phosphate | 8 | 4.00 | 0.33 | 3.67 | 24.08 | 3.01 | 1.635 | 1.278 | | Mg/l |
| 12 | Dissolve oxygen | 8 | 0.90 | 0.25 | 0.65 | 22.14 | 2.76 | 0.1991 | 0.446 | 7 | - |

**Table 5 Nigeria Standard Organisational Values For Drinking Water Quality Nis554:2007**

| Parameters | Unit | Maximum permitted level | Health impact |
|---|---|---|---|
| Aluminum (Al) | Mg/l | 0.2 | Potential neuro- degenerative disorder |
| Arsenic (As) | Mg/l | 0.01 | Cancer |
| Barium (Ba) | Mg/l | 0.7 | Hypertentaion |
| Cadium (Cd) | Mg/l | 0.003 | Toxic ot the kidney |
| Chloride (Cl) | Mg/l | 250 | None |
| Chromium ($Cr^{6+}$) | Mg/l | 0.05 | Cancer |
| Conductivity | µs/cm | 1000 | None |
| Copper ($Cu^{2+}$) | Mg/l | 1 | Gastrointestinal disorder |
| Cyride ($CN^{-}$) | Mg/l | 0.01 | Very toxic to the thyroid and the nervous system |
| Fluoride ($F^{-}$) | Mg/l | 1.5 | Fluor osis, skeletal tissue(bone |

| | | | |
|---|---|---|---|
| | | | and teeth) and teeth morbidity |
| Hardness as $Caco_3$ | Mg/l | 150 | None |
| Hydrogensulphide ($H_2S$) | Mg/l | 0.05 | None |
| Iron ($fe^{+2}$) | Mg/l | 0.3 | None |
| Lead (Pb) | Mg/l | 0.01 | Cancer interference with Vitamin D metabolism, affect mental development in infancts toxic to the central and peripheral nervous system |
| Magnesium ($Mg^{+2}$) | Mg/l | 0.20 | Consumer acceptability |
| Manganese ($Mn^{+2}$) | Mg/l | 0.20 | Neurological disorder |
| Mercury (Hg) | Mg/l | 0.001 | Affect the kidney and central nervous system |
| Nickel (Ni) | Mg/l | 0.02 | Possible carcinogenic |
| Nitrate ($No_3$) | Mg/l | 50 | Cyanosis and asphyxia (blue baby syndrome in infanct under 3 months) |
| Nitrite ($NO_2$) | Mg/l | 0.2 | Cyanosis and asphyxia (blue baby syndrome in infanct under 3 months) |
| Ph | ______ | 6.5____ 8.5 | None |
| Sodium (Na) | Mg/l | 200 | None |
| Sulphate ($So_4$) | Mg/l | 100 | None |
| Total dissolve solid (TDS) | Mg/l | 500 | None |
| Detergent | Mg/l | 0.01 | Possible carcinogenic |
| Minerals oil | Mg/l | 0.003 | Possible carcinogenic |

**The Physical Parameters**

Physical parameter such as the pH Turbidity, Hardness, Total Dissolve solid, Conductivity and Total Alkalinity are discussed below:

**pH:** The world Health Organization standard limits for pH is 6.8 - 8.5 while the result of the analysis of pH in water are 7.50, 6.99, 7.99, 6.99, 8.00, 7.90, 7.03, and 7.53 The result showed that water sample analyzed has a mean pH value of 7.49 with highest pH value of 8.00 and minimum pH value of 6.99 recorded from sample location L2 in the area. The result shows that the pH of the water in the study area lies within the permissible limit by World Health Organization. Therefore it is safe for drinking.

**Total Alkalinity:** The values of water sample analyzed have a mean alkalinity value of 7.49mg/l with the highest alkalinity value of 82.01 mg/l and lowest alkalinity level of 31.41 at location L8. These are comparable with the W.H.O standard of 100mgl of potable water, the range of the result in the analyses carried out on the various source for alkalinity at different location are: 67.00, 82.01, 58.95, 47.01, 43.00, 33.00, 33.00, 31.11 respectively.

**Total Dissolved Solid (TDS) &Turbidity:** The total dissolved solid has maximum value of 92.05 and minimum 76.02 which are within the limit set by the World Health Organization of 1000mg/l. It has a maximum value of 0.99mg/l and the minimum value of 0.01mg/l. The mean value is 0.53mg/l and it is within the World Health Organization value of 500mg/l for portable water quality.

**Conductivity:** It has a minimum value of 8.59mg/l and the maximum value 12.15mg/l which is within the W.H.O of recommended limits of $1.500 \times 10^6$ of drinking water quality.

**CHEMICAL ANALYSIS ELEMENTS**

The chemical elements analysed are as follows: Zinc, Lead**,** Arsenic**,** Cobalt**,** Cadmium, Iron**,** Magnesium**,** Manganese**,** Sellenium**,** Beryllium, Potassium**,**Thallium**,** Sodium, Nickel**,** Copper**.** Gold

**Sodium :** The W.H.O standard for portable drinking water indicate that a result whose range is within 5mgl is suitable for consumption, sodium according to analysis has a mean value of 0.08mg/l and maximum value of 0.91mg/l and the minimum value of 0.01mg/l, the result indicate the suitability of sodium content in the sample area.

**Chloride:** The World Health Organization standard shows guideline of 250mg/l as a limit for consumable water. The mean value of (Cl) in the samples collected at NIOMCO Itakpe is 1.34 whereby it has a maximum value of 5.53 and the minimum value of 0.02mg/l, this show that the chloride content is suitable.

**Sulphate:** The World Health Organization standard shows guideline of 200mg/l as a limit for consumable water. The mean value of (S) in the samples collected at NIOMCO Itakpe is 10.17 whereby it has a maximum value of 23.0 and the minimum value of 4.04mg/l, this show that the chloride content is suitable.

**Phosphate:** The World Health Organization standard shows guideline of 200mg/l as a limit for consumable water. The mean value of (P) in the samples collected at NIOMCO Itakpe is 3.01 whereby it has a maximum value of 4.00 and the minimum value of 0.33mg/l, this show that the chloride content is suitable.

**Iron:** The World Health Organization standard (WHO) for iron is 0.3mg/l (WHO 2011) and the result of the analysis carried out on that samples collected from the (8) eight location are 23.02, 35.00, 31.01, 44.01 46.87, 38.57.27.50, and 2.50mg/l respectively. The water resources of the study area shows that the 8 water samples analyzed for iron (Fe) are not within the range of the World Health Organization standard, there the element are not safe for consumption

**Magnesium (Mg):** WHO standard for Magnesium (Mg) is 0.5 (mg/l), our analyzed result gave us figures such as! 16.95, 16.50, 525, 12.31, 9.22, 8.71, 10.12, and 0.12mg/l respectively.These results shows that it is not portable for drinking except location L8 which was found within the range of WHO standard.

**Zinc (Zn):** WHO standard for Zinc (Zn) is 5mg/l whereby we have the following value 1.24, 3.00, 4.15, 2.00, 3.95, 3.93, 2.98, and 0.91mg/l respectively. With these result, it show that the zinc content in the sample is not acceptable by the WHO standard which means the water is not healthy for consumption.

**Lead (Pb):** WHO standard for Lead (Pb) is 5mg/l whereby we have the following values for each locations 1.24, 3.00, 4.15, 2.00, 3.95, 3.93, 2.98, and 0.91mg/l respectively. With these result, it show that the Lead content in the sample is not acceptable by the WHO standard which means the water is not healthy for consumption.

**Arsenic (As):** WHO standard for Arsenic (As) is 0.01mg/l whereby we have the following values for each locations: 3.90, 1.00 2.99, 3.80, 2.82, 1.12, 5.1 and 0.09mg/l respectively. With these result, it show that the Arsenic content in the sample is not acceptable by the WHO standard which means the water is not healthy for consumption.

**Copper (Cu):** WHO standard for Copper (Cu) is 2.0mg/l whereby we have the following values for each location: 0.96, 0.85, 0.23, 0.72, 0.85, 0.75, 0.65, and 0.26mg/l respectively. With these result, it show that the copper content in the sample is acceptable by the WHO standard which means the water is healthy for consumption.

## IV. CONCLUSION

The result shows that the water from industrial effluents in the study area had larger content of heavy metals such as Pb, As Mg and Fe. Although high levels of heavy metals are dangerous to both aquatic s and terrestrial life. Yet, there are some factors affecting their absorption by the soil and of course their availability to the plants. This finding implies that the consumption of the polluted water by animals or human beings could be hazardous to their health. The soil contaminated by the effluent will produce unhealthy food as heavy metals can enter the food chain

With these results, therefore, i recommended that all water sources intended for human consumption should be properly checked and treated to comply with Nigerian standards for drinking water quality that meet the minimum requirements sets out by W.H.O Standards and receive authorization from minstery of health.

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