International Journal of Innovative Biosciences Research 5(2):1-9, April-June, 2017

© SEAHI PUBLICATIONS, 2017 www.seahipaj.org ISSN: 2467-8457

Assessment of Hydrocarbon Level in Surface Water Aligning Imirigi Oil field Facilities in the Niger Delta

Enetimi I. Seiyaboh & Yowei W. Ayibaefie

Department of Biological Science, Faculty of Science, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria
***Corresponding Author's E-mail: seiyabohenetimi@gmail.com**

ABSTRACT
This study investigated the physico-chemical properties of water around Imirigi oil facilities. 12 water samples were collected from 4 locations including upstream, midstream, downstream and control. The water was analyzed using standard procedures. Resulted of the total hydrocarbon content ranged from 2.06mg/l (upstream) to 2.32mg/l (downstream) and control being 0.08mg/l. other supporting results showed that pH, Total suspended solid, total hardness, magnesium, potassium, iron, Salinity, conductivity, turbidity, Total dissolved solid, nitrate, chloride, sulphate, biocarbonate, total alkalinity, calcium, sodium and manganese content ranged from 6.28 – 6.60, 2.12 – 2.56mg/l, 39.33 – 50.00mg/l, 2.18 – 3.26mg/l, 1.18 – 1.53mg/l, 0.04 – 0.10mg/l, 0.04 – 0.44mg/l, 72.67 – 112.97 µS/cm, 5.36 – 10.73NTU, 26.57 – 58.00mg/l, 0.12 – 0.32mg/l, 11.00 – 15.83, 1.28 – 4.87mg/l, 0.87 – 2.00mg/l, 36.67 – 48.00mg/l, 7.24 – 12.49mg/l, 3.59 – 6.84mg/l and 0.003 – 0.027mg/l respectively. Analysis of variance showed that there is significance difference ($P<0.05$) among the various parameters except for pH, Total suspended solid, total hardness, magnesium, potassium, iron. The no significance difference ($P>0.05$) in total hydrocarbon content of water at upstream, midstream and downstream suggests that the hydrocarbon in the water is not from the oil field facilities. Again the range of salinity and pH level is also an indication that total hydrocarbon in the water is small to change the water quality.
Keywords: Hydrocarbon, oil facilities, Water pollution, Water quality,

1.0 INTRODUCTION

Water resources are frequently contaminated through anthropogenic activities in the environment and to lesser extent natural effects (Izah et al., 2016). Several activities that contribute to environmental pollution include emission from industries including agricultural, textile, oil and gas, manufacturing, and wastes (solid, liquid and gaseous) among others. In the recent times, environmental contamination has increased. Mogborukor (2012) reported that population growth; industrialization and urbanization are the major cause of environmental degradation in developing country like Nigeria.

Among the major environmental component is the water resource. Typically water is a vital resource needed for the survival, growth, proliferation and development for several species of life (Izah et al., 2016; Izah and Ineyougha, 2015; Izah and Srivastav, 2015, Agedah et al., 2015). According to Izah et al. (2016), water pollution occur through natural processes viz: weathering, decomposition of plants and animals remains or anthropogenic activities such as untreated wastewater discharge from agriculture, industries etc. Other specific industrial wastes that could lead to environmental contamination include effluents from manufacturing industries viz: mining, textile, metal extraction, dying chemicals, fertilizers, pesticides, cement, petrochemical, energy and power, leather, sugar processing, construction, steel, engineering, food processing etc (Idris et al. 2013; Izah and Angaye, 2016; Izah et al., 2016), sewage (Agedah et al., 2015; Ogamba et al., 2015a,b),wastes from abattoir (Ogamba et al., 2015c), wastes resulting from oil and gas operations.

Wastes that are deposited into the aquatic ecosystem directly or indirectly usually have impact on the aquatic resources including flora and fauna. This could also lead to adverse health impact on human that may consume such fish resource from contaminated surface water. In Nigeria, fisheries from the wild are a major source of animal protein especially to communities aligning surface water predominantly in the Niger Delta region. For instance, Bayelsa state which is of the Niger Delta region have been described as sedimentary basin and fishing is a major occupation of the local inhabitants of the region (Ohimian et al., 2009).

Water pollution typically involves the variation in the microbial (microbial counts or density and isolates/ diversity) and physico-chemical parameters (heavy metals viz: cadmium, iron, chromium, zinc, copper, arsenic, lead, manganese, cobalt, nickel, mercury; ions viz: calcium, magnesium, potassium, sodium, sulphate, nitrate, nitrite, phosphate etc and other in-situ parameters such as pH, conductivity, salinity, total dissolved solid, dissolved oxygen, temperature, turbidity). The alteration in the water quality parameters could lead to adverse effect on the downstream uses of such water.

Several water resources are found in the Niger Delta in different size including ocean, river, creek, stream, ponds, creeklets, rivulets (Agedah et al., 2015; Izah and Srivastav, 2015). The water resources found in the region are further classified as freshwater, brackish/ estuarine and salt water. The different class of water has some peculiar biota and characteristics accrued to it and they have been widely studied.

Specifically freshwater which is predominantly used for domestic purposes including washing, drinking, cooking etc abounds in Bayelsa state. Their physico-chemical characteristics have been widely studied including river Nun (Ogamba et al., 2015b; Agedah et al., 2015), Kolo creek (Ogamba et al., 2015a), Igbedi creek (Seiyaboh et al., 2013), Ikoli creek (Ogamba et al., 2015c; Seiyaboh et al., 2016a), Sagbama creek (Seiyaboh et al., 2017), Epie creek (Izonfuo and Benwari, 2001). Each of this surface water has some predominately anthropogenic activities being carried out close to the creek. For instance, Kolo creek has oil and gas facilities close to the water body.

Hydrocarbon is a major constituent of oil and gas. Hydrocarbon has detrimental impacts on the environment including air, soil and water. For instance, crude oil which consist of hydrocarbon could alter the characteristics of the environment such as soil (Aigberua et al., 2016a,b, 2017) and water resources. Since the Imirigi oil field is close to the surface water, the hydrocarbon content could be leaching into the water. As such there the need to frequently assess the water quality of surface water aligning oil and gas facility in the Niger Delta. Against this background, this study assessed the level of hydrocarbon in Imirigi oil field in the Niger Delta.

2.0 MATERIALS AND METHODS

Sampling Stations and Collection

In November, 2016, triplicate water samples were collected from four locations viz: upstream, midstream, downstream and control in surface water close to Imirigi oil field. The midstream is the region closest to the oil and gas facilities. I litre containers was used for sample collection. The samples were labeled accordingly and transported to the laboratory for analysis.

Physicochemical and heavy metal analysis

The water quality parameters were analyzed in-situ viz: pH, conductivity, salinity, turbidity, total dissolved solid, using multimeter. While Total suspended solid, nitrate, chloride, sulphate, bicarbonate, alkalinity, total hardness, calcium, potassium, magnesium, sodium using the method previously described by APHA (1975), Ademoroti (1996). Furthermore, iron and manganese was analyzed using atomic adsorption spectrophotometer. Total hydrocarbon content was analyzed using following ASTM D 9071B – 7 (Soxhlet Extraction Method) as previously described by Aigberua et al. (2016a).

Statistical Analysis

SPSS was used for the statistical analysis. The data were expressed as mean ± standard error. Thereafter, one way analysis of variance was used to show significance difference at P=0.05. Where there was significance difference, Duncan multiple range test statistics was used to compare the means.

3.0 RESULTS AND DISCUSSION

Table 1 presents the physicochemical properties of water samples from imirigi oil field. pH, Total suspended solid, total hardness, magnesium, potassium and iron content ranged from 6.28 – 6.60, 2.12 – 2.56mg/l, 39.33 – 50.00mg/l, 2.18 – 3.26mg/l, 1.18 – 1.53mg/l and 0.04 – 0.10mg/l respectively. There was no significance difference (P>0.05) between each of the location among the various parameters.

Salinity, conductivity, turbidity, Total dissolved solid, nitrate, chloride, sulphate, biocarbonate, total alkalinity, calcium, sodium, ranged from 0.04 – 0.44mg/l, 72.67 – 112.97 µS/cm, 5.36 – 10.73NTU, 26.57 – 58.00mg/l, 0.12 – 0.32mg/l, 11.00 – 15.83, 1.28 – 4.87mg/l, 0.87 – 2.00mg/l, 36.67 – 48.00mg/l, 7.24 – 12.49mg/l, 3.59 – 6.8 4mg/l, 0.003 – 0.027mg/l and 0.80 – 2.32mg/l respectively. There was significance difference (P<0.05) between each of the location among the various parameters.

Table 1: Physicochemical properties of water samples from imirigi oil field

Parameters	Control	Upstream	Midstream	Downstream
pH	6.28±0.00a	6.43±0.15a	6.40±0.20a	6.60±0.12a
Salinity, mg/l	0.44±0.00c	0.04±0.00a	0.04±0.00a	0.057±0.01b
Conductivity, µS/cm	72.67±0.33a	112.67±6.06b	103.20±3.60b	113.97±2.82b
Turbidity, NTU	10.73±0.03b	5.79±0.41a	5.36±0.65a	5.60±0.18a
Total dissolved solid, mg/l	36.57±0.07a	58.00±4.54b	53.23±3.32b	56.93±1.34b
Total suspended solid, mg/l	2.56±0.00a	2.12±0.41a	2.33±0.18a	2.19±0.17a
Nitrate, mg/l	0.32±0.00b	0.13±0.02a	0.12±0.00a	0.12±0.00a
Chloride, mg/l	15.83±0.07b	15.33±0.88b	12.67±0.67a	11.00±1.00a
Sulphate, mg/l	4.87±0.01d	3.33±0.30c	1.28±0.06a	2.14±0.14b
Bicarbonate, mg/l	2.00±0.00c	1.33±0.17b	0.83±0.17a	1.07±0.07ab
Total alkalinity, mg/l	38.67±0.33a	36.67±1.67a	39.33±1.20a	48.00±2.65a
Total hardness, mg/l	50.00±0.00a	39.33±7.54a	41.00±4.04a	46.67±3.76a
Calcium, mg/l	12.49±0.07c	10.22±0.64b	7.44±0.23a	7.24±0.55a
Magnesium, mg/l	2.44±0.02ab	3.26±0.19b	2.18±0.39a	2.39±0.31ab
Sodium, mg/l	6.84±0.01c	4.79±0.04b	3.59±0.16a	3.62±0.32a
Potassium, mg/l	1.43±0.01a	1.53±0.14a	1.37±0.27a	1.18±0.06a
Iron, mg/l	0.08±0.00a	0.10±0.04a	0.04±0.01a	0.04±0.01a
Manganese, mg/l	0.027±0.00b	0.007±0.003a	0.003±0.00a	0.003±0.003a
Total hydrocarbon content, mg/l	0.80±0.00a	2.06±0.17b	2.17±0.26b	2.32±0.20b

Data is expressed as mean ± standard error; Different letters across the row indicate significant difference (P<0.05) according to Duncan statistics

The level of total hydrocarbon content is presented in Figure 1. The total hydrocarbon content ranged from 2.06mg/l (upstream) to 2.32mg/l (downstream) and control being 0.08mg/l. apart from the control, there was no significance difference among the variation locations viz: upstream, midstream and downstream.

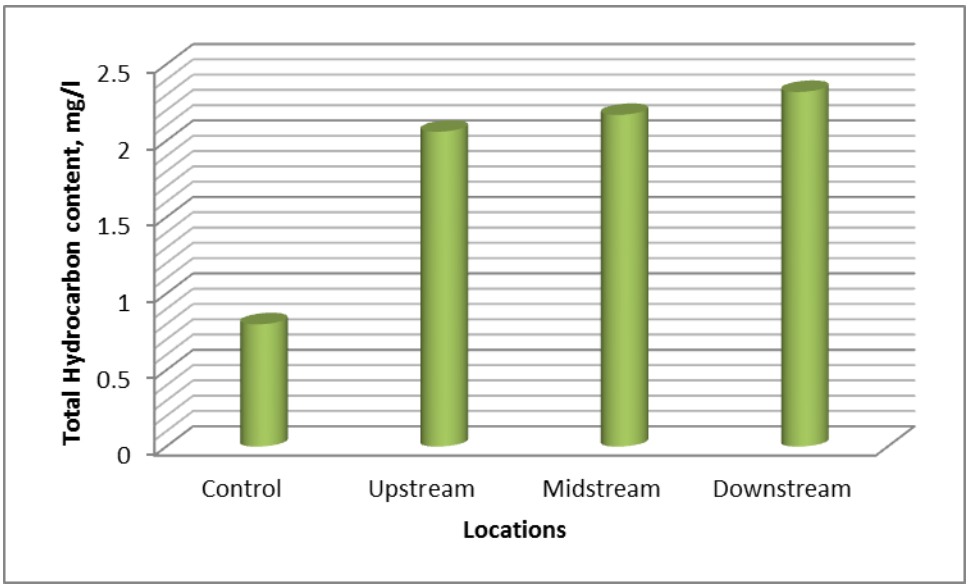

Figure 1: Level of Total Hydrocarbon content in surface water close to Imirigi oil field facilities

4.0 DISCUSSION

Based on the general physicochemical water quality parameter of Imirigi oil facilities, the various parameters analyzed are discussed below.

pH

The pH of showed no significant variation (P>0.05) among the control and other locations (upstream, downstream and midstream). The water pH is slightly acidic. The pH of the water was lower than the values previous reported in literature in surface water in Bayelsa state. The values reported in different location including Tombia bridge construction area (7.4 – 7.6) (Seiyaboh *et al*., 2013a), Igbedi creek (7.11 – 7.32) (Seiyaboh *et al*., 2013b), Kolo creek (6.61 – 7.5) (Ogamba *et al*., 2015a; Aghoghovwia and Ohimain, 2014), Nun river (6.525 – 7.350) (Ogamba *et al*., 2015b; Agedah *et al*., 2015), Epie creek with a value 7.4 – 7.57 (dry season) and 6.9 – 7.33 (wet season) (Izonfuo and Bariwari, 2001). But comparable to the values of 6.55 - 7.20 reported in Efi lake of Sabagreia by Angaye and Mieyepa (2015), 6.13 – 6.95 reported in Sagbama creek (Seiyaboh et al., 2017), 6.52 – 7.06 reported in Orashi river (Seiyaboh et al., 2016b). The slight variation could be due to season of study and changes in anthropogenic carried out in the water prior to sampling.

Salinity

The salinity of content in this study was slightly lower that the values reported in surface water in Bayelsa state. Some of this study have a value of 0.003 – 0.04‰ from Kolo creek (Ogamba *et al*., 2015a; Aghoghovwia and Ohimain, 2014), 0.000 – 0.017mg/l from Nun river (Ogamba *et al*., 2015b). But comparable to the values of 0.010 – 0.050‰ from River Nun (Agedah *et al*., 2015). The slight variation suggests difference in anthropogenic activities affecting the salinity content of the water.

Conductivity

The conductivity level of the water in this study was comparable to the values reported in other surface water in Bayelsa state. Some of the surface water include Tombia bridge construction area (87 – 95 umhos/cm) (Seiyaboh *et al*., 2013a), Igbedi creek (64.91 – 97.41 umhos/cm) (Seiyaboh *et al*., 2013b), Orashi river (25.07 – 82.33 µS/cm), Kolo creek (31.60 – 102.00 µS/cm) (Ogamba *et al*., 2015a; Aghoghovwia and Ohimain, 2014), Epie creek with a value of 78.33 – 89.33 µS/cm (dry season) and 47.73 – 54.00 µS/cm (wet season) (Izonfuo and Bariweni, 2001). But lower than the values of 33.167 – 68.00 µS/cm reported in Nun river by Ogamba *et al*. (2015b), Agedah et al. (2015), 48.13 - 68.93 µS/cm reported in Efi lake by Angaye and Mieyepa (2015), 60.57 – 67.33 umhos/cm reported in Sagbama creek (Seiyaboh et al., 2017). Generally, the magnitude of conductivity is a useful indication of the total

concentration of the ionic solutes (Ogamba *et al*., 2015b). The difference suggests variation in ionic content of the water probably due to difference in anthropogenic activities.

Turbidity

The turbidity of the water samples in this study is near the Nigeria water quality guideline of 5NTU apart from the control samples. The values reported in this study is far lower than the values reported in several surface water in Bayelsa state including some rivers around Wilberforce Island (25.70 – 117.252 NTU) (Ogamba *et al*., 2015b; Agedah *et al*., 2015), Tombia bridege construction area (5 – 64NTU) (Seiyaboh *et al*., 2013a), Igbedi creek (35.95 – 82.32) (Seiyaboh *et al*., 2013), Kolo creek (27.37 – 40.5 (Aghoghovwia and Ohimain, 2014; Ogamba *et al*., 2015a), Efi lake (7.87-17.29 NTU) (Angaye and Mieyepa, 2015), Sagbama creek (21.80 – 23.03 NTU) (Seiyaboh et al., 2017), Orashi river (22.17 – 31.23NTU) (Seiyaboh et al., 2016b), Epie creek with a value of 11.67 – 19.67 NTU (dry season) and 16.67 – 28.00 NTU (wet season) (Izonfuo and Bariweni, 2001). Turbidity is a major indicator of the anthropogenic effects such as runoff from construction, agricultural practices, logging and wastes water discharge (Seiyaboh et al., 2013a). As difference in human activities in the water ways could account for the variation in the turbidity level of the water.

Total dissolved solid

The total dissolved solid of the water has some is comparable to the values reported in surface water in Bayelsa state including kolo creek (41.45 – 51.0mg/l) (Aghoghovwia and Ohimain, 2014), Igbedi creek (31.93 – 39.48mg/l) (Seiyaboh *et al*, 2013b), Tombia bridge construction area (62.1 – 67.9mg/l) (Seiyaboh *et al*., 2013a), Epie creek with a value of 55 - 62 mg/l (dry season) and 33 – 37.33 mg/l (wet season) Izonfuo and Bariwani, 2001), Efi lake (54.25 – 102.92 mg/l) (Angaye and Mieyepa, 2015). But lower than the value 10.333 – 34.333mg/l reported in River Nun by Ogamba *et al*. (2015b), Agedah *et al*. (2015), 16.10 – 19.23mg/l reported in Kolo creek by Ogamba *et al*. (2015a), 30.09 – 33.5mg/l reported in Sagbama creek (Seiyaboh et al., 2017), 6.77 – 12.58mg/l reported in Orashi river (Seiyaboh et al., 2016b). Again, variation could be due to flow rate of the river and prevailing anthropogenic activities in the various surface water.

Total suspended solid

The total suspended solid of water samples in this study is lower than the concentration previously reported in some surface water in Bayelsa state. Some of the surface water include River Nun (3.4333 – 5.466 mg/l) (Ogamba *et al*., 2015b), comparable to values reported in Kolo creek (1.75 – 3.42mg/l) (Ogamba *et al*., 2015a), and higher than the values reported in Kolo creek (0.05 – 0.25mg/l) by Aghoghovwia and Ohimain (2014). Differences in prevailing anthropogenic activities could be the contributing factor of variation in total suspended solid content of water samples. Again, the suspended solid of water gives information about the microbial density because it's in the suspended solid that microbes anchors in water.

Sulphate

The sulphate concentration of water samples is lower than the values reported in some surface water in Bayelsa state. Some the water bodies include Igbedi creek (6.09 – 8.83mg/l) (Seiyaboh *et al*., 2013b), but higher than the values also reported in some surface water including River Nun (0.566 – 0.866 mg/l) (Ogamba *et al*., 2015b), Kolo creek (0.1 – 0.567mg/l) (Aghoghovwia and Ohimain, 2014; Ogamba *et al*., 2015a) and comparable to the values from Epie creek with a value of 1.98 – 2.66 mg/l (dry season) and 2.22 – 6.27 mg/l (wet season) (Izonfuo and Bariweni, 2001), River Orashi (2.10 – 4.53mg/l) (Seiyaboh et al., 2016b), Sagbama creek (0.52 – 2.62mg/l) (Seiyaboh et al., 2017). Sulphate in the water could be due to anthropogenic activities, depicting nutrient content in the water (Ogamba *et al*., 2015b).

Nitrate

The nitrate concentration of water samples in this study is comparable with the concentration previously reported in some surface water in Bayelsa state. Some of the surface water include river nun (0.117 – 0.394 mg/l) (Ogamba *et al*., 2015b), Igbedi creek (0.092 – 0.226mg/l) (Seiyaboh *et al*., 2013b), Sagbama creek (0.12 – 0.13mg/l) (Seiyaboh et al., 2017), River Orashi (0.03 – 0.38mg/l) (Seiyaboh et al., 2016b), Epie creek with a value of 0.02 – 0.27 mg/l and 0.14 – 0.28 mg/l for dry and wet season respectively from Epie creek (Izonfuo and Bariweni, 2001), Kolo creek (0.1 – 0.24 mg/l) (Ogamba *et al*., 2015a;

Aghoghovwia and Ohimain, 2014). But higher than the values from river nun (0.330 – 0.813 mg/l) as reported in some surface water in Wilberforce Island (Agedah *et al*., 2015), and lower than the values from Tombia bridge construction area (0.32 – 4.15mg/l) (Seiyaboh *et al*., 2013a), Efi Lake (1.34 - 2.82mg/l) (Angaye and Mieyepa, 2015). Nitrate is one of the nutrient determinant parameters. The variation suggests that nutrient composition in the water differs.

Bicarbonate

The bicarbonate concentration of the water samples was significantly higher in the control sample. Basically, carbonate in water is as result of dissolved ions, dissolved carbon dioxide in the water. As such, the concentration of bicarbonate in the water samples is an indication that that the water contains anion, which tend to be significantly affected by the activities in the Imirigi area of oil field facilities.

Chloride

The chloride concentration of the water samples is far higher than the concentration reported in some surface water in Bayelsa state. Some of the surface water include Igbedi creek (0.36 – 0.46mg/l) (Seiyaboh *et al*., 2013b), Sagbama creek (2.27 – 3.33mg/l) (Seiyahboh et al., 2017), River Orashi (0.03 – 0.38mg/l) (Seiyaboh et al., 2016), Epie creek with a value of 1.65 – 4.62 mg/l (dry season) and 3.62 – 4.28 mg/l (wet season) (Izonfuo and Bariweni, 2001), Kolo creek (1.257 – 1.467 mg/l) (Ogamba *et al*., 2015a), River Nun (0.50 – 3.47mg/l) (Ogamba *et al*., 2015b). Higher chloride level suggests high concentration of cation such as sodium.

Alkalinity

The alkalinity concentration of water samples were lower than the concentration reported in some surface water in Bayelsa state. Some of the surface water include Epie creek with a concentration of 30.37.33 mg/l (dry season) and 15.33 – 22.00 mg/l (wet season) (Izonfuo and Bariweni, 2001), but lower than the values of 50.64 – 67.61 mg/l reported from Igbedi creek Seiyaboh *et al*. (2013b). The alkalinity level in the water gives information about the acidity of the water. As such variation in the alkalinity concentration in this study compared to previous studies could also be due to anthropogenic activities in the water and season of sampling.

Total Hardness

The total hardness concentration of the water samples is far higher than the concentration reported in surface water in Bayelsa state. Some of the surface water include River Nun (0.903 - 3.333 mg/l) (Ogamba *et al*., 2015b), Epie creek with vale of 3.27 – 5.27 mg/l (dry season) and 2.27- 3.36 mg/l (wet season) (Izonfuo and Bariweni, 2001), Kolo creek (1.03 – 1.37mg/l) (Ogamba *et al*., 2015a), Sagbama creek (3.10 – 3.82mg/l) (Seiyaboh et al., 2017), River Orashi (1.70 – 4.17mg/l) (Seiyaboh et al., 2016). The higher hardness of the water compared to previous studied gives information that the water is hard and could waste soap during laundry services. The anthropogenic activities could be caused by other prevailing anthropogenic activities in the region. This because there was no significant variation ($P>0.05$) among the various locations the water was obtained from.

Calcium

The calcium concentration of the water samples was far higher than the values reported in surface water in Bayelsa state. Some of the surface water bodies and their corresponding literature values include River Nun (0.80 – 2.33mg/l) (Ogamba *et al*., 2015b), Kolo creek (1.107 – 1.183mg/l) (Ogamba *et al*., 2015a), Sagbama creek (1.01 – 2.22mg/l) (Seiyaboh et al., 2017), Epie creek during wet season (3.20 – 4.84 mg/l) (Izonfuo and Bariweni, 2001). But comparable to values reported in River Orashi (1.32 – 14.54 mg/l (Seiyaboh et al., 2016b), Epie creek during dry season (5.47 – 7.53 mg/l) (Izonfuo and Bariweni, 2001), High concentration of calcium in the water samples in this study is a reflection of higher cations in the water.

Magnesium

Magnesium concentration of the water samples was lower than the concentration previously reported in surface water in Bayelsa state. Some of the surface water include Kolo creek (0.37 – 0.5mg/l) (Ogamba *et al*., 2015a), River Nun (0.39 – 1.466 mg/l) (Ogamba *et al*., 2015b), Sagbama creek (0.63 – 0.85mg/l) (Seiyaboh et al., 2017). But comparable to the values reported in River Orashi (0.38 – 8.41mg/l) (Seiyaboh et al., 2016b), Epie creek with value of 2.29 – 3.60 mg/l (dry season) and 1.77 – 2.98 mg/l (wet

season) (Izonfuo and Bariweni, 2001). The higher magnesium content also gives information about the cation content of the water.

Sodium

The sodium concentration of the water samples in this study is far higher than the concentration previously reported in surface water in Bayelsa state. Some of the surface water include Kolo creek (0.58 – 0.68 mg/l) (Ogamba *et al*., 2015a), River Nun (0.55 – 1.31 mg/l) (Ogamba *et al*., 201bc), Sagbama creek (1.40 – 2.18mg/l) (Seiyaboh et al., 2017). But comparable to the values of 1.55 – 3.27mg/l reported in River Orashi (Seiyaboh et al., 2016b), 3.27 – 5.27 mg/l (dry season) and 2.27 – 3.36 mg/l (wet season) from Epie creek (Izonfuo and Bariweni, 2001). Higher sodium in water samples in this study gives information about the cation levels of the water.

Potassium

The potassium concentration of the water samples is higher than the concentration previously reported in surface water in Bayelsa state. Some of the surface water include Kolo creek (0.313 – 0.363 mg/l) (Ogamba *et al*., 2015a), River Nun (0.333 – 0.816 mg/l) (Ogamba *et al*., 2015b), Sagbama creek (0.64 – 1.06mg/l). But within the range of 1.08 – 8.35mg/l reported in River Orashi (Seiyaboh et al., 2016b), and lower than the value of 2.55 – 3.33 mg/l (dry season) and 2.55 – 3.35 mg/l (wet season) from Epie creek (Izonfuo and Bariweni, 2001). Like sodium, magnesium and calcium, high concentration of potassium is a function of high caution in the surface water under study.

The exchangeable cations including Calcium, potassium, sodium and magnesium play essential role in determining nutrient availability in water. High concentration of exchange cations gives information that the water is hard water. The trending of exchangeable cations in this study were in the order; calcium> sodium> magnesium> potassium. Similar trend has been reported by Izonfuo and Bariweni (2001) in dry season of Epie creek, Ogamba et al. (2015a) from Kolo creek. But varies from the trend of calcium> sodium> potassium >magnesium reported in Sagbama creek by Seiyaboh et al. (2017), calcium> magnesium> potassium> sodium reported in River Orashi by Seiyaboh et al. (2016b). Higher calcium in water has been variously reported in freshwater under Nigerian environmental condition. High level of anion could be from anthropogenic activities and material that have leached into the water via runoff.

Heavy metals (Iron and manganese)

The concentration of iron and manganese reported in this study is comparable to the values reported in surface water in Bayelsa state. Some of the values for iron and manganese have been respectively reported as 0.1 – 0.16 mg/l and 0.013 – 0.033 mg/l from Kolo creek (Ogamba *et al*., 2015a), 0.023 – 0.463 mg/l and 0.003 – 0.023 mg/l from River Nun (Ogamba *et al*., 2015b). geology of the area could be due to the concentration of heavy metal found in surface water in Bayelsa state.

Total hydrocarbon content

The total hydrocarbon content reported in this study should that the control samples were significantly lower than the upstream, midstream and downstream suggesting the effect of the surface water at Imirigi oil field facilities. However, the concentration at upper or upstream also gives indication that the hydrocarbon in the water may not be from the oil facilities but could be from other anthropogenic activities in the region.

There was no significant variation ($P>0.05$) in some parameters including pH, total suspended solid, total hardness, magnesium, potassium and iron) among the various locations the samples were collected. This suggests that oil and gas activities do not alter pH, total suspended solid, total hardness, magnesium, potassium and iron content of the water. Rather other anthropogenic activities and natural effects in the area affects the water hence no significant variation. Furthermore, concentration of conductivity, total dissolved solid and total hydrocarbon content were significantly lower compared to the upstream, midstream and downstream of the surface water around imiringi oil field. In addition, the water samples were significantly higher in the control for turbidity, nitrate, chloride, sulphate, bicarbonate, calcium, sodium and manganese. This suggests that surface water around imiringi oil field affects some water quality parameters resulting in lower concentration or higher level in water. The concentration of total hydrocarbon was significantly same for upstream, midstream and downstream, suggesting that the cause

of variation may not be from oil related activities around the field. But this could be associated to other anthropogenic activities carried out in the water.

5.0 CONCLUSION AND RECOMMEDATION

Water is one of the most vital resources need by human. Water is used by human for industrial and domestic activities in addition to drinking. In Bayelsa state, water transportation is common in the river and creek. Some oil and gas infrastructures are also located close to water bodies. This study evaluated the physicochemical quality of surface water around Imirigi oil facilities. The study found that the water parameters such as pH, total suspended solid, total hardness, magnesium, potassium and iron did not showed significant variation among the various locations including the control. Furthermore, the values were significantly higher in the control for turbidity, nitrate, chloride, sulphate, bicarbonate, calcium, sodium and manganese. Also conductivity, total dissolved solid and total hydrocarbon content were significantly lower compared to the upstream, midstream and downstream. Based on total hydrocarbon, the same concentration in upstream compared to downstream indicates that total hydrocarbon in the water may be from other anthropogenic source and not from the oil field facilities.

Based on the findings of this study, more study should be carried out on other hydrocarbon determinant such as polycyclic and aromatic hydrocarbon. Efforts should be made to trace the source of total hydrocarbon in the water and if possible control it.

REFERENCES

Ademoroti, C.M.A. (1996). *Standard Method for Water & Effluents Analysis.* 1st Edition. Foludex press limited, Ibadan, Nigeria.

Agedah, E.C., Ineyougha, E.R., Izah, S.C., and Orutugu, L.A. (2015). Enumeration of total heterotrophic bacteria and some physico-chemical characteristics of surface water used for drinking sources in Wilberforce Island, Nigeria. *Journal of Environmental Treatment Techniques*, 3(1): 28 – 34.

Aghoghovwia, O. A. and Ohimain, E. I. (2014). Physicochemical characteristics of lower Kolo creek, Otuogidi, Bayelsa state. *Nigerian Journal of Agriculture, Food* and *Environment,* 10(1):23 - 26.

Aigberua, A.O., Ekubo, A.T., Inengite, A.K. and Izah, S.C. (2016a). Evaluation of Total Hydrocarbon Content and Polycyclic Aromatic Hydrocarbon in an Oil Spill Contaminated Soil in Rumuolukwu Community in Niger Delta. *Journal of Environmental Treatment Techniques*, 4(4): 130 – 142.

Aigberua, A.O., Ekubo, A.T., Inengite, A.K. and Izah, S.C. (2016b). Seasonal variation of nutrient composition in an oil spill contaminated soil: a case of Rumuolukwu, Eneka, Port Harcourt, Nigeria. *Biotechnological Research*, 2(4):179-186.

Aigberua, A.O., Ekubo, A.T., Inengite, A.K. and Izah, S.C. (2017). Assessment of some selected heavy metals and their pollution indices in an oil spill contaminated soil in the Niger Delta: a case of Rumuolukwu community. *Biotechnological Research*, 3(1): 11- 19.

American Public Health Association (APHA) (1975). Standard methods for the evaluation of water and waste waters. 20th Ed. Wahington DC. American Public health.

Angaye, T.C.N. and Mieyepa, C.E. (2015). Assessment of Elemental and Microbial Quality of Lake Efi In Bayelsa State, Central Niger Delta, Nigeria. *Journal of Environmental Treatment Techniques*, 3(2): 71 - 75.

Idris MA, Kolo BG, Garba ST, Waziri I (2013). Pharmaceutical industrial effluent: heavy metal contamination of surface water in Minna, Niger State, Nigeria. Bull Environ Pharm Life Sci 2(3): 40-44.

Izah, S.C. and Ineyougha, E.R. (2015). A review of the microbial quality of potable water sources in Nigeria. *Journal of Advances in Biological and Basic Research,* 1(1): 12 – 19.

Izah, S.C. and Srivastav, A.L. (2015). Level of arsenic in potable water sources in Nigeria and their potential health impacts: A review. *Journal of Environmental Treatment Techniques,* 3(1): 15 – 24.

Izah, S.C., Chakrabarty, N. and Srivastav, A.L. (2016). A Review on Heavy Metal Concentration in Potable Water Sources in Nigeria: Human Health Effects and Mitigating Measures. *Exposure* and *Health,* 8:285–304.

Izonfuo, L.W.A. and Bariweni, A.P. (2001). The effect of urban runoff water and human activities on some physico-chemical parameters of the Epie Creek in the Niger Delta. *Journal of Applied Sciences* and *Environmental Management,* 5(1):47 - 55.

Mogborukor JOA (2012). Domestic sewage disposal and quality of water from hand dug wells in Ughelli, Nigeria. AFRREV STECH, An Inter J Sci Technol 1 (3):112-125.

Ogamba, E.N., Seiyaboh, E.I., Izah, S.C., Ogbugo, I. and Demedongha, F.K. (2015a). Water quality, phytochemistry and proximate constituents of *Eichhornia crassipes* from Kolo creek, Niger Delta, Nigeria. *International Journal of Applied Research and Technology,* 4(9): 77 – 84.

Ogamba EN, Izah SC and Oribu T. (2015b). Water quality and proximate analysis of *Eichhornia crassipes* from River Nun, Amassoma Axis, Nigeria. *Research Journal of Phytomedicine,* 1(1): 43 – 48.

Ogamba, EN, Izah SC and Toikumo, B.P. (2015c). Water quality and levels of lead and mercury in *Eichhornia crassipes* from a tidal creek receiving abattoir effluent, in the Niger Delta, Nigeria. Continental Journal of Environmental Science. 9(1): 13 – 25.

Ohimain EI, Bassey S, Bawo DDS (2009). Uses of seashells for civil construction works in coastal Bayelsa State, Nigeria: a waste management perspective. *Research Journal of Biological Sciences,* 4: 1025 – 1031.

Seiyaboh, E.I., Alagha, W.E. and Gijo, A.H. (2016a). Spatial and Seasonal Variation in Physico-chemical Quality of Ikoli Creek, Niger Delta, Nigeria. Greener Journal of Environment Management and Public Safety, 5 (5): 104-109.

Seiyaboh, E.I., Angaye, T.C.N. and Okogbue, B.C. (2016b). Physicochemical Quality Assessment of River Orashi in Eastern Niger Delta of Nigeria. Journal of Environmental Treatment Techniques, 4(4): 143-148.

Seiyaboh, E.I., Inyang, I.R. and Gijo, A.H. (2013a). Environmental Impact of Tombia Bridge Construction across Nun River in Central Niger Delta, Nigeria. *The International Journal of Engineering* and *Science,* 2(11): 32 – 41.

Seiyaboh, E.I., Izah, S.C. and Oweibi, S. (2017). Assessment of Water quality from Sagbama Creek, Niger Delta, Nigeria. Biotechnological Research, 3(1): 3(1):20-24.

Seiyaboh, E.I., Ogamba, E.N. and Utibe, D.I. (2013b). Impact of Dredging on the Water Quality of Igbedi Creek, Upper Nun River, Niger Delta, Nigeria. *IOSR Journal of Environmental Science, Toxicology* and *Food Technology,* 7(5): 51 – 56.