Advances In Multidisciplinary & Scientific Research
A Multidisciplinary & Interdisciplinary Journal
Vol. 4 No. 1, March 2018

Effects of Effluents from Warri Refinery on River Ogunu, Jala and Ubeji in Warri South Local Government Area, Delta State.

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ABSTRACT

The effects of effluent discharge from Warri Petrochemical Refinery on the water bodies of Ogunu River, Jala River and Ubeji River was investigated. It attempted to ascertain the nature of effluent released into the water bodies and also the effect of effluent on the water quality. Water samples were collected from fifteen different points in the study area. Five points from each of the water bodies studied. The data that were used in the research where generated from field measurement of pH, conductivity, Total hardness, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Turbidity and heavy metals profiles (Mg, Zn, Ni, Cl, Cu, H2S, S, P) from the Ogunu, Ubeji and Jala Rivers respectively. However, the Total suspended Solids (TSS), Turbidity, Chromium, Zinc and Copper recorded in Ogunu, Jala and Ubeji Rivers were found to be higher than the World Health Organization (WHO) and Federal Environmental Protection Agency (FEPA) Standard limits. Thereby making the water in this areas not suitable for consumption. In-situ measurements was employed for the physical parameters whereas chemical elements content in samples was measured using Atomic Absorption Spectrophotometer (AAS) and Gas chromatography for HC contents. Thus, it is evident that the activities of Warri Petrochemical Company (Warri refinery) constitutes a threat and if the pollution tendency continues unabated, the ongoing environmental degradation will reach a point that human existence will be threatened.

Keywords: Petrochemical, Refinery, Effluent discharge, Water body.

Aims Research Journal Reference Format:

Efienokwu, Jude Ngozichukwuka (2018): Effects of Effluents from Warri Refinery on River Ogunu, Jala and Ubeji in Warri South Local Government Area, Delta State. Advances in Multidisciplinary & Scientific Research Journal. Vol.4. No.1, Pp 113-120

1. INTRODUCTION

Globally, the effluents that are discharged from refinery system represent one of the largest sources of pollution. One of the major sources of water pollution is the discharge of effluents from petroleum industries into the surrounding environment, sometimes into the water bodies. For instance, during exploration or seismic surveys by oil companies, drill cuttings, drilling mud and fluids are used for stimulating production. There is also the use of chemicals during seismic activities. In the water, these materials are dispersed and sink and may kill local benthic organisms and animals by burying them (Oil of Poverty in Niger Delta, 2004). In addition, to the pollutants introduced into the environment from exploration and exploitation operations, refinery wastes also have characteristics which constitute potential land, water and air pollutants. The disposal of wastes into the sea from oil facilities has direct effects on fish stocks. The negative impact of these effluent to both human and aquatic ecosystem from harmful substances found in them have been documented both at national and international levels. Some of these impacts included death of aquatic life, algal bloom, habitat destruction from sediment debris, are crossed, water flow etc.
(Canada Gazette, 2010).

When significant deposits of oil were discovered in the 19th century, at a village of Oloibiri Bayelsa State located within the Niger Delta of Nigeria (Anifowose, 2008: Onuoha, 2008). Fossil fuel appeared to offer a limitless source of energy to drive development. The oil and energy supply provide multiple benefits to human society, but every stage in the lifecycle from exploration to use can have harmful effects on our health and the environment. Oil has brought a lot of wealth to the nation, as it is a major foreign exchange earner. It has boosted the economy by reducing unemployment, provided raw materials for local industries and for foreign exchange through export. Though, the oil industry is an enclave economy.

It has never the less provided some forward and backward linkages in the economy. Indeed, since the 1970s, crude oil has remained the linchpin of the nation's economic life, powering growth and development, accounting for 80% of the Nigerian government's revenue and 95% of the country's export earnings (Aghalino, 2015). Warri South Local Government area has an area of 633km^2 and a population of 303,417 at 2006 census. The area is predominantly riverine with large expenses of mangrove forests and has a land area of approximately 1,520 square kilometers. The climate of Warri is humid sub-equatorial long wet season lasting from March to October that alternates with a shorter dry season that last from November to February. The climate is influenced by two prevailing air masses namely the south –west monsoon wind and then North – east trade wind. Annual rainfall in the Warri area average temperature is up to 2500mm with double peak rainfall regime which takes place both in April and September. Annual average temperature is about 27^{0}C with no marked seasonal departure from the average.

This is due to the strategic important of oil in the Nigerian economy as well the importance of oil in world politics. Most of the literatures published centered around environmental and human right issues as it is related to oil exploitation in Nigeria and socio-economic problems of oil exploitation.

In 1970, Scott Pearson wrote a book titled '*Petroleum and the Nigerian Economy'*. The central concern of this book was on the impact of oil on the Nigeria economy, just like Schatzl's book. This book is merely on the economic analysis of the role of oil in the Nigerian economy. It also discussed the politics f oil in Nigeria. It did not make any mention of the environmental pollution associated with oil production, and the economic empowerment of the Niger Delta communities. Hence, in 1996, Deborah Robinson took the socio-anthropological approach and studied the impact of oil on the Ogoni community of the Niger Delta. Deborah studies pointed out that gas flaring due to oil operations adversely affected the community's environment, but environmental issues were not central in her study There are enormous literatures on Nigerian oil, oil operation in Nigeria's Niger Delta and Nigerian oil industry.

It is worthy of note to mention that the first major book published on Nigeria oil was in 1969 by Schatzl. It was published 13 years after the discovery of oil in Nigeria (Oil was discovered in Nigeria in 1956). However, the book focused essentially on the economic exploitation of oil and gas in Nigeria by the multinational oil companies especially Shell- Bp Development Company of Nigeria Limited. The book highlighted the importance of oil in the Nigerian economy and its importance as a major source of energy in Nigeria. But the book did not discuss the environmental and social impacts of oil operations on the indigenous people of the Niger Delta.

Oil prospecting in Nigerian has brought with it untold hardship to the environment. Dwellers of oil producing areas generally suffer from scarcity of farmlands as their lands have been made unproductive due to constant oil spillage and waste dumps. Nigeria is said to be the sixth largest oil producing country within the Organization of Petroleum Exporting Countries (OPEC) and the seventh largest oil producing countries in the world. Hence, the global importance of Nigeria's oil cannot be overemphasized. Apart from its global importance, oil revenue is the main source of Nigeria's annual foreign exchange earnings and contributes about 95 percent of the country's annual revenue (NNPC, 2008). Nigeria's oil deposits are naturally located in the Niger Delta region of the country inhabited by indigenous people. Oil exploitation in Nigeria started over 50 years ago.

The major causes of spill incidence in Nigeria today include pipelines and flow lines leakage/blowout, blowout from well heads due to poor maintenance and damage and spills from flow station. These spillage affects vast stretches of land and water ways thus polluting not only crops but also marine life and the source of water for domestic uses. Mangrove forest are particularly vulnerable to oil spill because the soil soak up the oil like sponges and release it every rainy season (Adeyemi,2014). However, the Global Marine Oil Pollution Information Gateway (2015) noted that the main source of oil pollution in the marine environment include land-based activities (either discharging directly or through river inputs), marine transport, atmospheric deposition, coastal refineries and off shore installations.

One of the most visible consequences of numerous oil spills had been the loss of mangrove trees. The mangrove was a source of both fuel for the indigenous people and a habitat for the areas biodiversity, but is now unable to be sourced due to the oil toxic effects on the habitat. Oil spills pose serious health risks to people when they consume contaminated seafood (Bogardy, 2005; Onuoha, 2007). Kuehn *et al.* (2008) observed that refinery effluent contaminated with aromatic hydrocarbons produces poor health and lethal toxicity to tilapia. Onwumere and Oladimeji, (2010) earlier demonstrated that accumulation of heavy metals are accompanied by histopathology in *Oreochrominis niloticus* on when exposed to untreated effluents from petroleum refinery and petrochemical company. Drinking contaminated water can cause various diseases such as typhoid fever, dysentery, cholera and other intestinal diseases (Udoh, 2007; Adeyemi, 2004; Atubi, 2010). Nigeria has experienced increased pipeline vandalism, kidnappings and militant take-over of oil facilities in the Niger Delta, By April 2007, an estimate 587, 000bb/d of crude oil production was shut-in since December 2005, Nigeria has lost an estimated 16 billion dollars in export revenues due to disruption of oil production.

Shell has incurred the majority of shut-in oil production leading to drop in product of about (477,000bb/d), followed by Chevron (70,000bb/d), and Agip (40,000bb/d), (Energy Information Administration, 2007). In a related development, environmental pollution has been seen as a living phenomenon in Nigeria especially in Niger Delta region of the country in which Warri township is not exempted. This region has recorded several cases of the effect of pollution such as gas flaring, oil spillage in the environment due to pervasive presence and operation of oil and gas companies in the area especially Warri refinery and Ekpan (Nduka and Orisakwe, 2009). Oil in the aquatic environment may be damaging in a variety of ways. These may involve changes in the composition of aquatic communities that affect their ability to survive, permanent damage and, in some cases, massive mortalities. Odour, taste and colour are present in oil polluted water. Oil pollution of water also constitute a potential health risk to humans who use water for domestic and drinking purposes and consume fish found therein (Nwilo and Badejo, 2005; Helmer, 2008; Atubi, 2009). In any refinery and production plants, lots of pollutants are produced as a by-product or chemicals and ranges from gaseous, liquid and solid wastes at different stages. These pollutants constitute a threat to the environment and so the oil industry in Warri Area is not an exception. It was observed that the activities of the oil industries not excluding warri refinery exert great demand on the environment especially in terms of resources extraction and waste generation (Ugboma, 2012).

The effect of oil pollution on the environment has given concern in the area following the incidence of oil spillage as a result of leakages due to corrosion, mal operation of line pegging unit and illegal bunkering. The toxic crude seeps into the ground and is taken up by the roots of the plants. Recent studies have shown that oil spills lower soil fertility and cause poor growth of plants (Ugboma, 2012; Atubi, 2011; Obafemi *et al*., 2012). The question that agitates their mind is finding the best solution that can be adopted to check pollution in the area. This study is aimed at identifying some of the modes of waste disposal of the oil industry in Warri South Local Government Area in order to assess the effect, on the environment. Other studies submitted that petroleum refinery effluents pose a serious problem to both aquatic and human life forms.

This study examines the effect of the effluents discharge from Warri refinery and petrochemical company within the Ogunu, Jala and Ubeji rivers in Warri South Local Government of Delta State.

2. MATERIALS AND METHODS

The materials used in this research work are water samples from Ogunu, Ubeji and Jala Rivers in Warri South Local Government Area, Delta State. All the chemicals used were of analytical grade and procured by by Department of Science Ltd Poole England. Distilled water, hexane, Dichloromethane, Acetone, Silica gel, Sodium tetraoxosulphate (VI). Glasswares, metal container (buckets), amber bottles, digital camera, ice chest with wet ice, nitrile disposable gloves, Ziploc bags, paper towels, stainless steel spoons, liquinox soap, Aluminum foil, cleaning brush, separating funnel, stirrer, rotary evaporator, vial tubes, syringe, Gas chromatography flames Ionization Detector (GCFID), oven.

2.1 Description of the Study Area

The study areas are, Ubeji, Ogunu and Jala located in Warri South, Delta state, Nigeria. Ubeji has surface location of 366,140.12m Easting and 174,200.08m Northing. The Ubeji community is situated beside the Warri Refinery and petrochemical Company (WRPC). The landforms consist essentially of sedimentary basins and basement complex rocks (Ija and Antai, 2003).

2.2 Sample Collection

Samples were collected from five (5) locations of 100m apart, location 1(Ubeji 1) is 100m from the point of effluent discharge in the month of March 2017. The same was done in Ogunu and Jala rivers. Water samples were collected at low tide with a 1 litre plastic hydrobios water sampler and transferred to clean 1 litre polyethylene containers and 250ml capacity borosilicate glass bottles. They were rinsed several times with water at the point of collection. All samples are transported in ice chest and analysed for pH, conductivity and turbidity within 12hours of collection. Other physicochemical parameters were analysed later using refrigerated samples.

2.3 Water Analysis

Conductivity, turbidity, Total Suspended Solid (TSS), Total Dissolved Solid (TDS) and pH were measured using HACH water analysis kits (model DR 2010). An HACH DR / 2000 spectrophotometer was used for determination of phosphate, sulphide, total hardness, magnesium hardness and chloride. All analysis were carried out using standard methods for the examination of water and wastewater as adopted by Uzoekwe, S.A. and Oghosanine, F.A (2011). A Perkin Elmer 3100 atomic absorption spectrophotometer (Boston, MA 02118 – 2512, USA) was used for the determination of the heavy metals including nickel (Ni), zinc (Zn), copper (Cu) and chromium (Cr). .

3. RESULTS AND DISCUSSION

Physiochemical characteristics and some metals in this research work are: pH, conductivity, turbidity, total dissolve solid (TDS), total suspended solid (TSS), total hardness, magnesium hardness, chloride, phosphate and hydrogen sulphide were tested for in water samples from Ogunu, Jala and Ubeji rivers. Zinc, nickel, copper and chromium were the metals analysed for in water samples from Ogunu, Jala and Ubeji rivers.

Table1 .Physiochemical Characteristics and Some Metals in Ogunu River

Parameters	Ogunu	Ogunu	Ogunu	Ogunu	Ogunu	WHO Standard
P^H	5.8	6.1	5.6	5.8	5.9	6.5 to 8.5
Conductivity	70.5	80.1	82	80.1	81.5	500 μ s/cm
Total Hardness	40	42	38	36	41	100mg/l
Magnesium Hardness	30	32.5	31	33	30.5	250mg/l
Chloride (mg/L)	30	29	29.5	31	30	-
Turbidity	70.2	160	271	172	71.3	25NTU
Phosphate	4.9	4.7	4.5	4.6	4.1	-
Hydrogen Sulphide (H_2S)	2.25	1.9	1.7	2.2	2.0	-
Total Dissolved Solid (Tds)	78	69	69.5	75	79	1000mg/l
Total Suspended Solid (Tss)	55.2	57	59	62	64	<30mg/l
Zinc (mg/L)	0.048	0.047	0.042	0.041	0.029	5.00mg/l
Nickel (mg/L)	0.029	0.036	0.042	0.041	0.040	6 μ g/l
Copper (mg/L)	0.012	0.013	0.015	0.011	0.013	50 μ g/l
Chromium	0.061	0.059	0.055	0.054	0.059	50 μ g/l

The table above shows the physiochemical characteristics and some metals in Ogunu river. It is observed from the table that the pH of water samples from Ogunu river ranges from 5.6 – 6.1, conductivity ranges from 70.5 - 82 μ s/cm, total hardness ranges from 36 -42mg/l, chloride ranges from 29 – 31mg/l, turbidity ranges from 70.2 -271, phosphate ranges from 4.1 – 4.9, hydrogen sulphide ranges from 1.7 – 2.25, total dissolved solid (TDS) ranges from 69 – 79mg/l and total suspended solid (TSS) ranges from 55.2 – 64mg/l, zinc ranges from 0.029 – 0.048mg/l, nickel ranges 0.029 – 0.042mg/l, copper ranges from 0.011-0.05 μ g/l, and chromium ranges from 0.054 – 0.061.

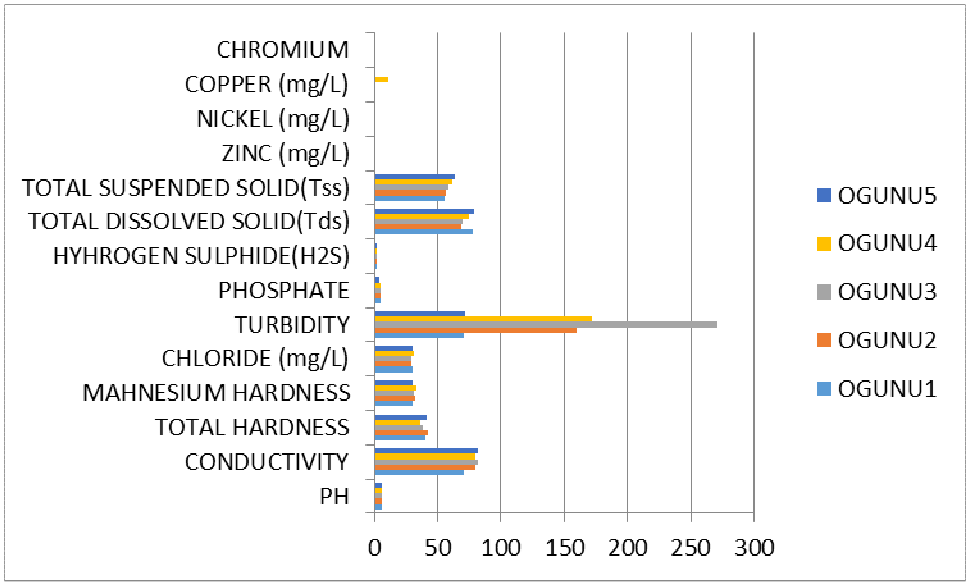

Fig 1: A Bar Chart Representation of 5 Different Points In Ogunu Water Body

Table 2: Physiochemical Characteristics and Some Metals in Jala River

Parameters	Jala	Jala	Jala	Jala	Jala	WHO Standard
P^H	6.0	6.1	6.1	5.9	5.7	6.5 to 8.5
Conductivity	88	92	91	98	82	500 μ s/cm
Total Hardness	43	41.5	39.5	38	39	100mg/l
Magnesium Hardness	32	30.5	31	33	31.5	250mg/l
Chloride (mg/L)	33	32	31.2	31,6	30	-
Turbidity	180	85	80	105	85	25NTU
Phosphate	4.8	4.2	4.1	4.3	4.4	-
Hydrogen Sulphide (H_2S)	1.8	2.2	2.1	2.0	1.8	-
Total Dissolved Solid (Tds)	82	81.5	79.3	68	72.3	1000mg/l
Total Suspended Solid (Tss)	63	64.3	63.1	58	59.8	<30mg/l
Zinc(mg/L)	0.035	0.029	0.031	0.034	0.042	5.00mg/l
Nickel(mg/L)	0.041	0.032	0.041	0.033	0.025	6 μ g/l
Copper(mg/L)	0.011	0.015	0.013	0.014	0.009	50 μ g/l
Chromium	0.038	0.035	0.036	0.04	0.05	50 μ g/l

The table above shows the physiochemical properties and some heavy metals in Jala river. As observed from the table, the pH values of the water samples from Jala river ranges from 5.7 – 6.1, conductivity values ranges from 82 - 98 μ s/cm, total hardness ranges from 38 – 43mg/l, magnesium hardness ranges from 30.5 -33mg/l, chloride ranges from 30 – 33mg/l, turbidity ranges from 80 – 180NTU, phosphate ranges from 4.1 – 4.8, hydrogen sulphide ranges from 1.8 – 2.2, total dissolved solid (TDS) ranges from 72.3 – 82mg/l, total suspended solid (TSS) ranges from 58 – 64.3mg/l, zinc ranges from 0.029 – 0.041mg/l, copper ranges from 0.009 – 0.015mg/l, and chromium ranges from 0.035 μ g/l.

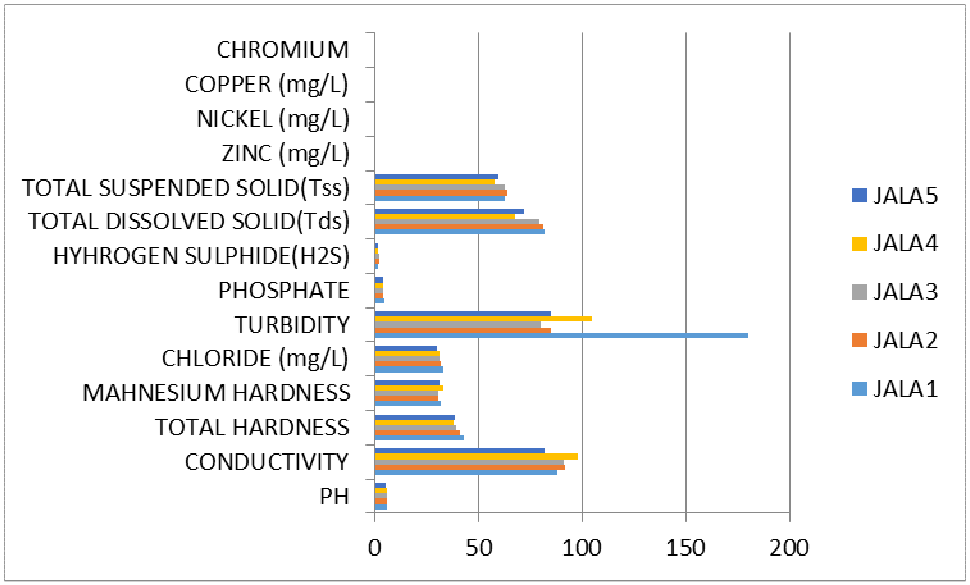

Fig. 2: A Bar Chart Representation Of 5 Different Points In Jala Water Body

Table 3. Physiochemical Characteristics and Some Metals in Ubeji River

Parameters	Ubeji	Ubeji	Ubeji	Ubeji	Ubeji	WHO Standard
P^H	5.5	6.1	5.7	5.6	5.9	6.5 to 8.5
Conductivity	72.5	75	79	89	90	500 μ s/cm
Total Hardness	40	38	39	43	41.5	100mg/l
Magnesium Hardness	32	33	34	32	31.5	250mg/l
Chloride (mg/L)	32	31.2	30.5	31	30.5	-
Turbidity	102	71.3	150.8	78	180	25NTU
Phosphate	4.3	4.7	4.3	4.5	4.6	-
Hydrogen Sulphide (H2S)	1.7	1.8	1.9	1.7	1.9	-
Total Dissolved Solid (Tds)	80	81	76	79	77	1000mg/l
Total Suspended Solid (Tss)	70.5	69.3	59.3	63	69	<30mg/l
Zinc (mg/L)	0.032	0.034	0.041	0.04	0.033	5.00mg/l
Nickel (mg/L)	0.031	0.050	0.039	0.0026	0.042	6 μ g/l
Copper (mg/L)	0.015	0.013	0.011	0	0.02	50 μ g/l
Chromium	0.042	0.051	0.009	0.02	0.01	50 μ g/l

The table above shows the result of physiochemical properties and some heavy metals in Ubeji river. As observed from the table, the pH values of Ubeji river water samples ranges from 5.5 – 6.1, conductivity values ranges from 72.5 - 90 μ s/cm, the total hardness values of Ubeji river water samples ranges from 38 – 43mg/l, while magnesium hardness ranges from 32 – 34mg/l. The chloride values ranges from 30.5 – 32mg/l, turbidity ranges from 71.3 – 180 NTU, phosphate values ranges from 4.3 – 4.7, hydrogen sulphide ranges from 1.7 – 1.9mg/l, total dissolved solid (TDS) values ranges from 76 – 81mg/l, and total suspended solid (TSS) values ranges from 59.3 – 70.5mg/l. Also from table 3.3 above, the values of zinc ranges from 0.032 – 0.041mg/l, nickel ranges from 0.0026 – 0.050mg/l, copper ranges from 0.000 – 0.02mg/l and chromium ranges from 0.009 – 0.05mg/l.

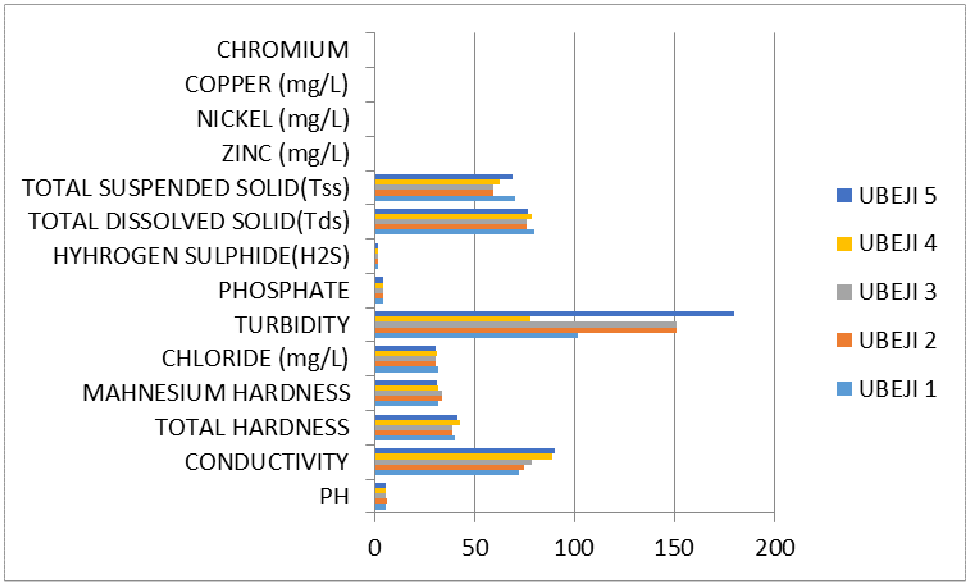

Fig. 3A Bar Chart Representation Of 5 Different Points In Ubeji Water Body

4. CONCLUSION

This study revealed that there have been environmental pollution in relation to effluent discharge by Warri Refinery and Petrochemical Company in the host communities of Ubeji, Jala and Ogunu. The study revealed that the refinery constitutes a potential hazard to the surrounding rivers of Ubeji, Jala and Ogunu communities of Warri South by way of contributing to the presence and increase concentration of heavy metals in the water sample collected. The discharge of pollutants of various types in varying magnitude by the activities of Warri refinery, have great impacts on the livelihood of the residents of the area in terms of the food consumed, among others. The land, and water have been degraded and in effect human health have been impaired and the fragile ecosystem been exposed to more danger.The accumulation of these heavy metals if unchecked may reach to a level of concentration that is dangerous to human health, as there were few health facilities like hospitals, clinics, dispensaries and maternity centers amidst various forms of pollution in Warri.

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