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A COMPARATIVE ASSESSMENT OF THE PHYSICOCHEMICAL, MICROBIAL PROPERTY AND THE LEVELS OF SOME HEAVY METALS IN EKEREKANA CREEK IN RIVERS STATE

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ABSTRACT

The comparative assessment of the physicochemical and biological analysis of Ekerekana creek was investigated between the months of July to September. Samples were collected monthly, from three different points. Temperature readingswere27-32^{o}C, turbidity values were 0.55-3.52 NTU. PH values obtained were 6.5-9.4. Results obtained for conductivity was 130–970 µS/cm. Total suspended solids (TSS), Total dissolved solids (TDS) and Total solids (TS) were determined by the gravimetric method. The values were zero. The following values were obtained for Chloride (31.20-93.6 mg/L), Nitrate (13.10-33.3 mg/L), PO_4^{3-} (0.33-0.47 mg/L), Magnesium (20.85-26.06 mg/L), Calcium (30.19.13-33.89 mg/L) and Alkalinity (0-20 mg/L). Dissolved oxygen (DO), Biological oxygen demand (BOD) and Phosphate (PO_4^{3-}) were determined by standard methods (APHA, 1998). The values obtained for DO was 17.81-36.10 mg/L, BOD was 2.0-7.31mg/L and COD was 10.40-41.60 mg/L. From the results obtained, pH, Temperature, Turbidity, Electrical conductivity, BOD, COD, Alkalinity, TSS, TS, TDS, Cl^-, NO_3, PO_4^{3-}, Ca^{2+}, Mg^{2+} were below WHO standard for the three months, except pH in the month of September, temperature for the month of July and September and electrical conductivity for the month of August that were above WHO standards. DO mean values obtained for both August and September were above WHO standard. The bacterial colony count was determined using the standard plate count method and the mean bacteria colony count values were 11.33-159 CFU/ml. Heavy metal analysis was carried out using AAS. Cu and Cr were not detected for the three months. The relative dominance of metals in the water, followed the sequence Ni> Co>Cd>Pb> Zn> Fe>Mn. The level of Ni, Pb and Cd were above WHO standards for the three months of study while Mn, Zn and Co were below WHO standard. The results obtained showed that Ekerekana creek is polluted and the pollution may be as a result of the discharge of effluents from the refining company and other anthropogenic sources.

KEYWORDS: *Physicochemical, Effluent, Ekerekana, Creek, Pollution, Heavy Metals*

Article History

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INTRODUCTION

Background of Study

The quality of water available and accessible to a community has tremendous impact on their living standard and well-being, thus global and local efforts at ensuring adequate provision of clean and safe water to the Nigeria's growing population (DWAF, 2003). Although water plays an essential role in supporting human life and biodiversity, it also has a great potential for transmitting diseases when contaminated. Population growth coupled with other factors such as urbanization, agricultural activities, industrial and commercial processes has resulted in the accumulation of wastes and pollutants which end up in water bodies, thereby altering the water quality species composition and biodiversity in many aquatic systems (Dike *et al.*, 2004). Most areas where rivers are situated have experienced quick economic development and urbanization and have become economic centers for the populace. This rapid developers and corresponding human activities have had severe influences on the water environments (Oluwayemisi *et al.*, 2015). In Nigeria most of the rivers have become polluted due to the discharge of domestic sewage and industrial effluents into the water bodies such as rivers, streams and lakes. The wastes find their way into the environment as gaseous, liquid or solid materials. They apparently have impacts on the environment and the flora and fauna in the receiving media (Kuforij and Ayandiran, 2013). The improper management of water systems may cause serious problems in the availability and quality of water. Water Pollution is a serious problem for the entire world. It threatens the health and well-being of humans, plants and animals. As the world becomes more industrialized and smaller due to communication and trade, accidental and purposive hazardous dumping has contributed to the problem of water pollution (Mbaneme *et al.*, 2013). From studies carried out by Makinde *et al.* (2015) on the comparative assessment of physical and chemical characteristics of water in Ekerekana and Buguma creeks, Niger Delta, Nigeria, significant differences were recorded in all the parameters investigated in both creeks in all the months of study. Variations were observed in all the parameters with the exception of pH, alkalinity and water hardness. Conversely, temperature, conductivity, salinity and nitrates were significantly higher in the dry season in both creeks while the biological oxygen demand, turbidity, total dissolved solids, sulfates and chlorides were elevated in the wet season. The study showed that the industrial effluent discharged into Ekerekana creek resulted in the presence of high concentration of pollutants in the water body. The various pollutants (industrial effluents, fecal matters, domestic wastes, etc.) released into the creek affect the shallow waters along the shore where rooted vegetation grow. The limited ability of the creek to flush out these pollutants amplifies the pollution damage (Oruibima, 2004). Hence, the need for the present study to assess the physicochemical,microbial property and the level of heavy metal concentrations of the creek with a view to providing additional information on this water body as a reference point when-assessing changes caused by nature or man.

Study Area

Ekerekana Creek is located in the Okrika Local Government Area of Rivers State and is spatially located between latitude 04^0 and 50^0N and longitude 07^0 and 10^0E (Makinde *et al.*, 2015). It flows from Okochiririver and empties into Okari river. The inhabitants of the community over the years used the creek for fishing and swimming purposes. It is the receptor of the community's domestic wastes and fecal matters as well as the receiving water body of the effluent from the refining company. Over the years thick oil scum is seen floating all over the surface of the creek, especially around the mangroves and prop roots of aquatic plants. Nevertheless, the creek serves as home to many aquatic foods such as fish, crab, prawn, crayfish, etc. In recent times there have been reports from fishermen in the creek of tainted fish tissues, a development they attributed to possible pollution of the water body with improperly treated refinery effluent (Mbaneme *et al*., 2013).

MATERIALS AND METHODS

Sample Collection

Water samples were collected randomly from three different points that were far apart on a monthly basis between July to September. The samples were collected in 2L white plastic containers, during sampling the containers were rinsed with sample water before filling with the samples. After collection the containers were closed properly and taken to the laboratory for analysis.

Physicochemical Analysis

The samples collected were analyzed for pH, turbidity, temperature, alkalinity, electrical conductivity, total suspended solids, total solids, total dissolved solids, biological oxygen demand, chemical oxygen demand, chloride, nitrate, phosphate, calcium, magnesium, and dissolved oxygen. The temperature was measured in-situ using mercury in glass thermometer and Turbidity was determined using standardized XinRuiWaz-IB turbid meter. The electrical conductivity was determined using Hanna (EC 215 model) conductivity meter. The pH was determined using a universal pH indicator reagent.. Total suspended solids (TSS), Total dissolved solids (TDS) and Total solids (TS) were determined by gravimetric method. Chemical oxygen demand (COD), Chloride (Cl^-), Nitrate (NO_3), Magnesium (Mg^{2+}), Calcium (Ca^{2+}), Alkalinity was determined by titrimetric methods according to APHA (1998).

Microbial Analysis

The number of bacterial colonies was measured by standard plate count using standard nutrient agar. Microbial analysis of the river water samples was studied within 24hrs of collection, the numbers of bacterial colonies were counted by digital colony counter. Bacterial populations were expressed as colony forming units per milliliter (cfu/ml)

Heavy Metals Analysis

The water samples were analyzed for the heavy metals Cr, Cu, Co, Ni, Mn, Pb, Fe, Cd and Zn are using the Atomic Absorption Spectrophotometer (Reliegh WFF 320 model).

RESULTS AND DISCUSSIONS

The results of the physicochemical, microbial and heavy metals analysis of Ekerekana creek are presented in the appendix. The pH values 6.5-9.4. The least value was observed in the month of August while the highest value was observed in the month of September. The pH value recorded for the month of September was above the WHO limit. From the pH values for the three different months, the creek is said to be alkaline. This supports the findings of Marcus and Ekpete (2014) and Makinde *et al.* (2015). According to Chindah*et al.* (2004) and Akinrotimi *et al.* (2014) the higher pH value in Ekerekana may be associated with high fresh water emptying into the creek from the adjourning streams and municipal drains. The mean water temperature values recorded in this study ranged between 27-32^{o}C. The month of August had the lowest temperature value while the highest temperature value was recorded for the month of September. The change in values of the temperature can be as a result of varying weather conditions. The temperature value for the month of September was above the WHO standard limit while the temperature values for both July and August were within WHO standard limit.The mean turbidity values recorded in this study ranged from 0.55-3.52 NTU, the lowest turbidity value was recorded in the month of September while the highest value was observed in the month of August.

The values obtained for turbidity for the three months were within WHO standard limits less than 5 NTU. The values obtained in this study for conductivity were 130-970 µS/cm, the lowest values obtained in this study value were recorded in the month of July while the highest value was observed in the month of August, and the low value in conductivity can be attributed to the presence of low dissolved solids in the water body. The electrical conductivity value obtained in the month of August was above WHO standard, while electrical conductivity values for both July and September where within WHO standard. The mean Dissolved oxygen (DO) values recorded in this work ranged from 17.8- 36.1 mg/l, the lowest value was recorded in the month of August while the highest value was recorded in the month of September. The DO values obtained for the two months were above the WHO standard. Higher values in DO indicate the degree of pollution of the creek as a result of the reduction in aerobic microorganisms and aquatic lives responsible for the depletion of dissolved oxygen. This can be attributed to the discharge of untreated or incompletely treated refinery effluents into the creek.

The BOD values recorded in this study are from 2.0-7.3 mg/l. The lowest value was recorded in the month of August while the highest value was recorded in the month of September. The BOD values in this study are in correlation with the findings of Makinde *et al*. (2015), the values obtained were within WHO recommended limit. COD values recorded in this study are from 10.14 – 41.6 mg/l, the lowest value was recorded in the month of July while the highest value was recorded in the month of September. The COD values obtained for the three months were within WHO recommended standard.

The alkalinity values were from 0 – 20 mg/l with the lowest value recorded in the month of August while the highest value was recorded in the month of September. According to Agbaire and Obi (2009) high alkaline and high pH shows the ability of the water to support algal growth and other aquatic life.

The values for TSS, TS and TDS recorded for the three months were zero. This is as a result of high tide and continuous rainfall. The concentration of chloride in this study was 31.2 – 93.6 mg/l, the lowest value was recorded in the month of July while the highest value was recorded in the month of August. The chloride values recorded for the three months were within WHO standard. The concentration of phosphate, nitrate, calcium and Magnesium were all below the WHO limit and this is acceptable. The number of bacterial colony count was highest for the month of September and least in the month of August. From the results obtained for the heavy metals, Cr and Cu were not detected for the three months while Ni had the highest concentration for the three months. The concentration level of the heavy metals in the three months, followed the order Ni> Co>Cd>Pb> Zn> Fe>Mn. The concentrations of Ni, Co, Pb and Cd recorded for the three months were above WHO standard except for the concentration of Fe for the month of September that was below WHO standard Lead (Pb) exposure has been associated with hypo chromic anemia with basophilic stifling of erythrocytes; cadmium is highly toxic and accumulate in the body and eventually causes effects such as disturbances in calcium homeostasis and metabolism (Emory *et al.,* 2001).

CONCLUSIONS

The creek is observed to be polluted with a high level of heavy metals as Ni, Pb, and Cd which are hazardous to both humans and aquatic lives when they bioaccumulate in the body. Generally, high level of metals may also be attributed to the discharge of effluents by the refining company, fecal matters, and other anthropogenic activities. It is therefore recommended that the water quality of the creek should be continuously monitored to assess the level of pollution and the construction of good dumpsites and toilet facilities to discourage sewage and waste discharge into the water body.

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APPENDICES

Study Area

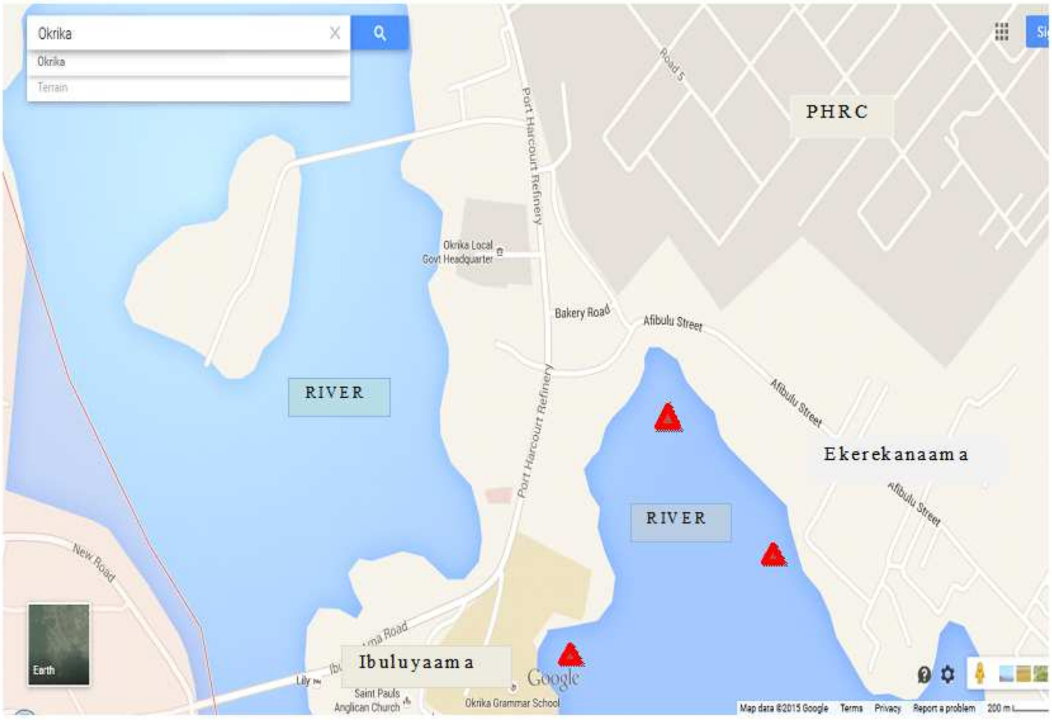

Figure 1

Map of Study Area

▲ Sampling points

Point of Discharge of Refinery Effluent into the Creek

Discharge of Faecal Matters on Water Body from Public Toilet

Thick oil Scum from Refinery Effluent Floating on Water Body

Debris Floating on Water Body

Figure 2

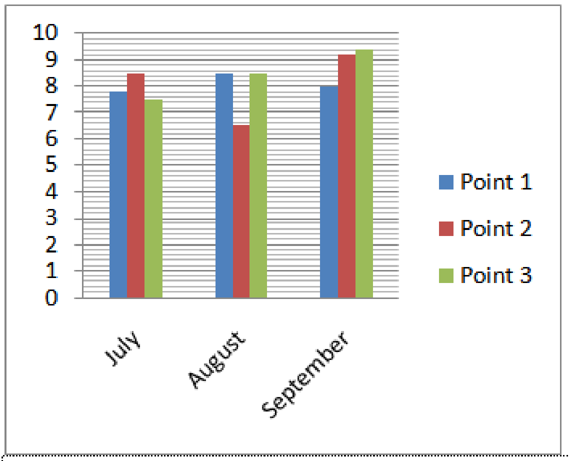

Figure 3: pH

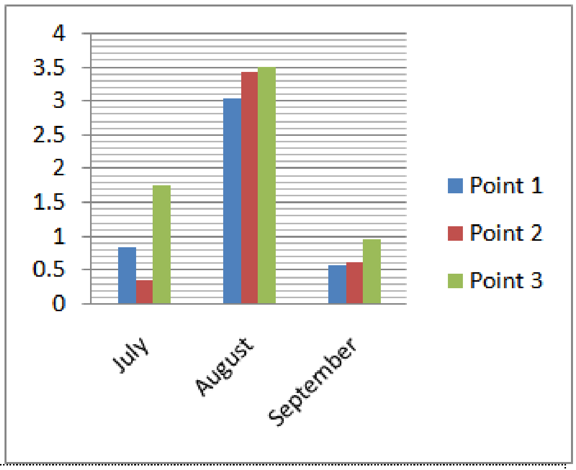

Figure 4: Turbidity

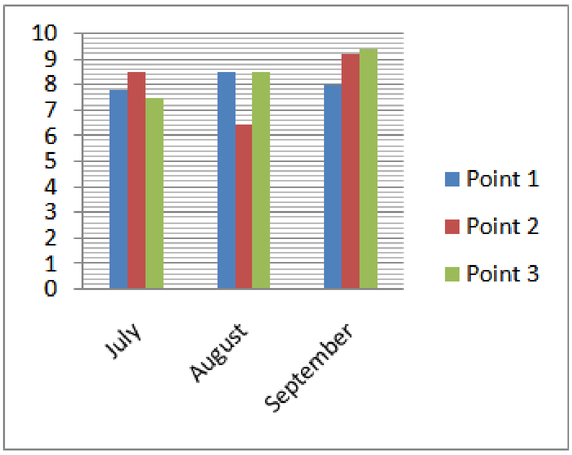

Figure 5: Temperature

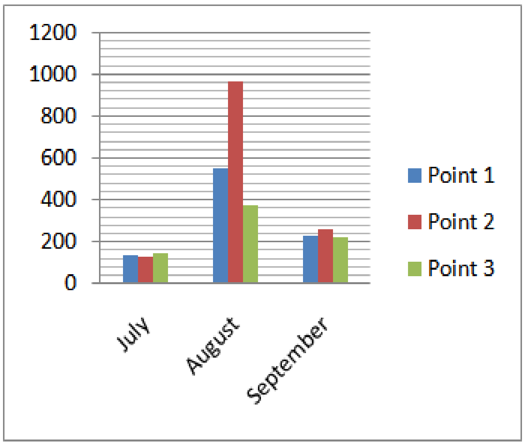

Figure 6: Electrical Conductivity

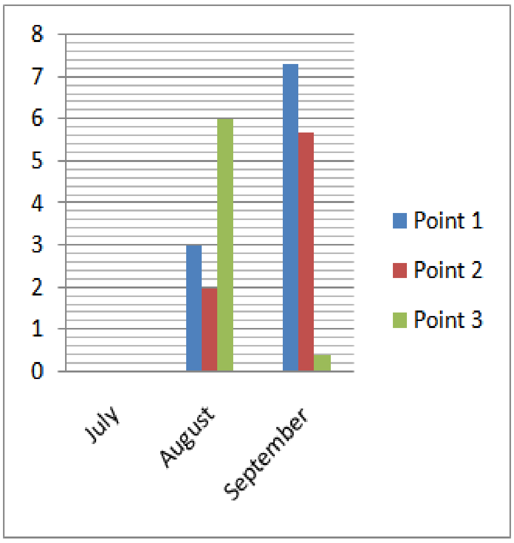

Figure 7: BOD

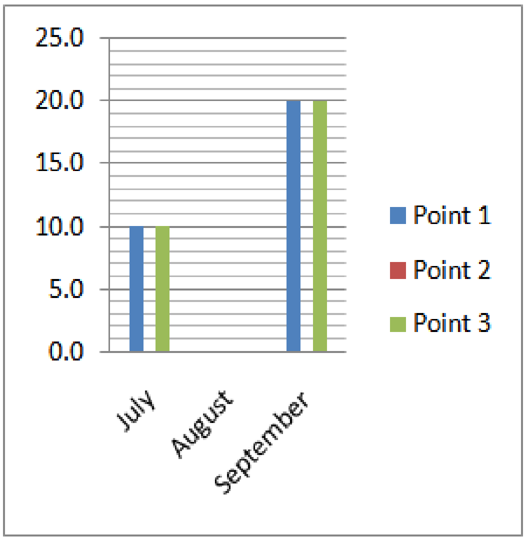

Figure 8: Alkalinity

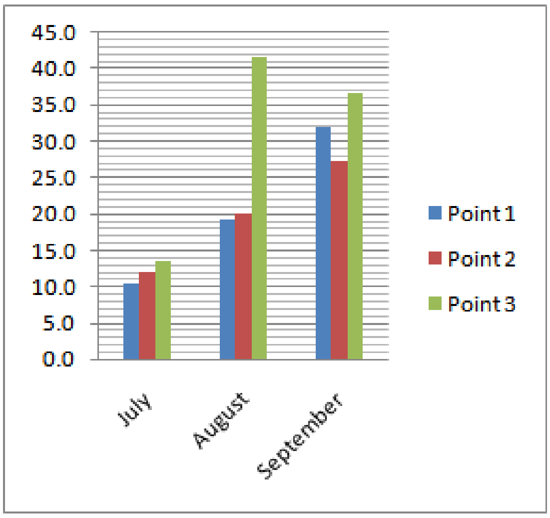

Figure 9: COD

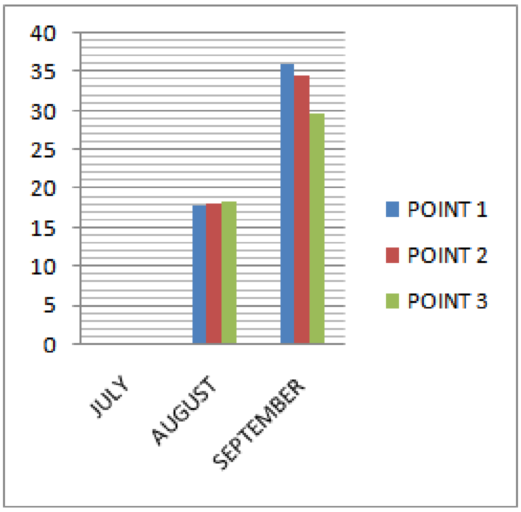

Figure 10: DO

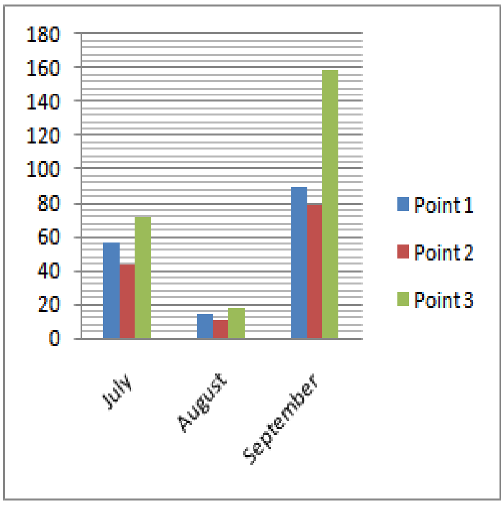

Figure 11: Bacterial Colony Count

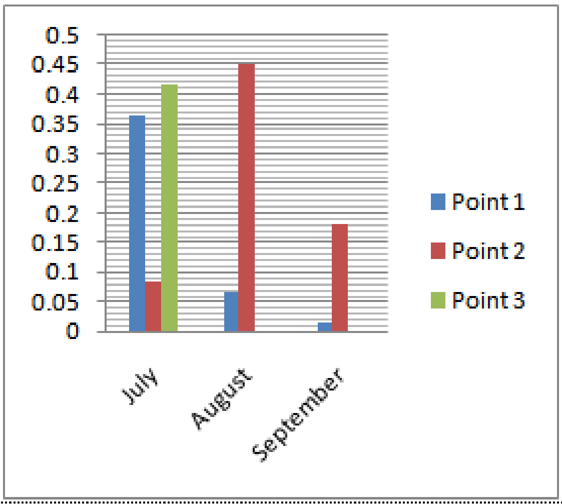

Figure 12: Co Concentrations

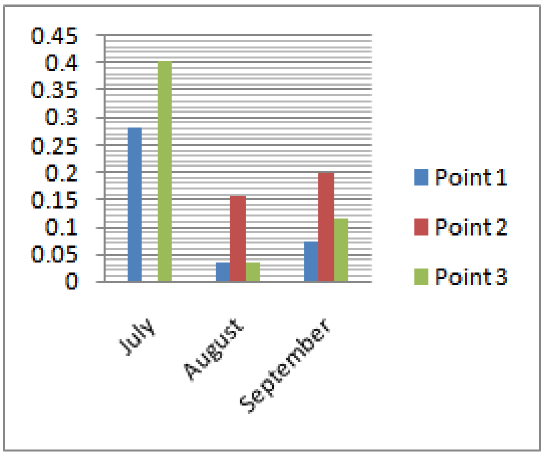

Figure 13: Pbconcentrations

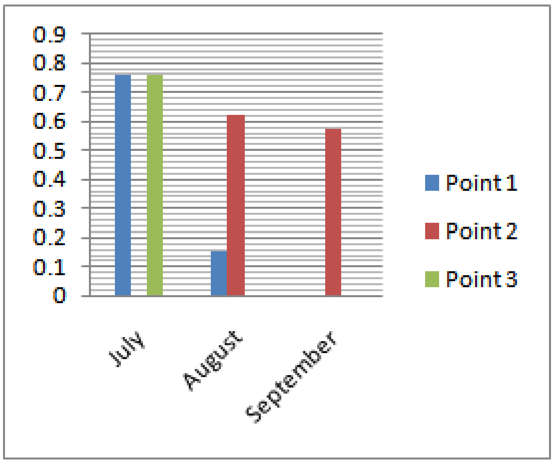

Figure 14: Ni concentrations

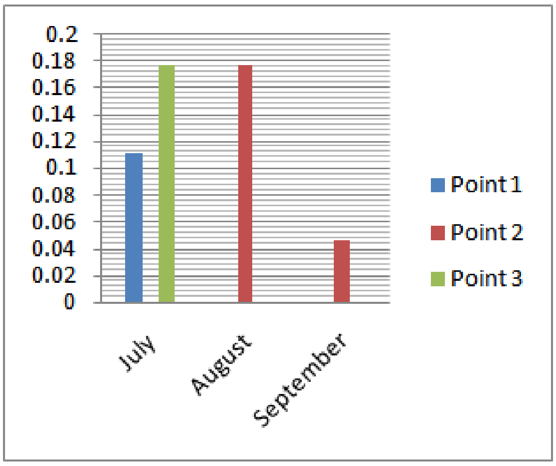

Figure 15: Fe Concentrations

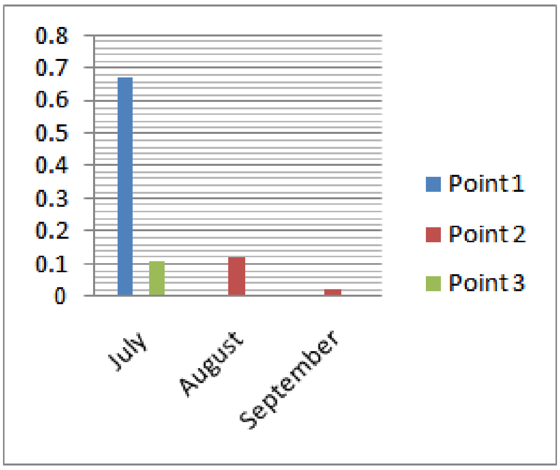

Figure 16: Cd Concentrations

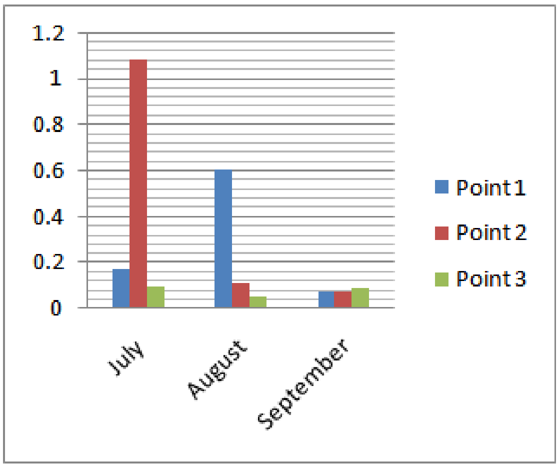

Figure 17: Zn Concentrations

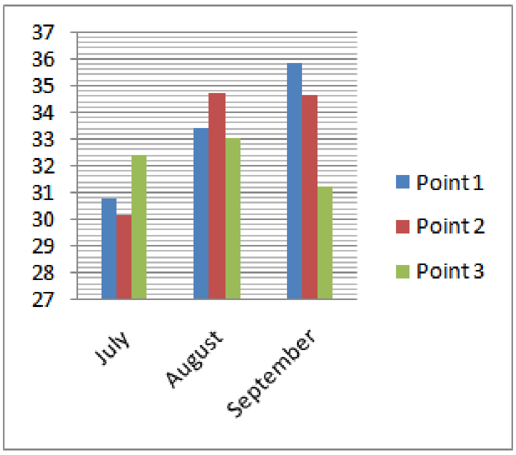

Figure 18: Ca^{2+}Concentrations

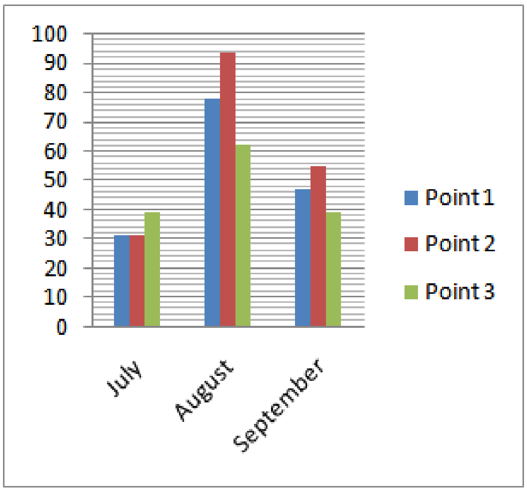

Figure 19: Cl- Concentrations

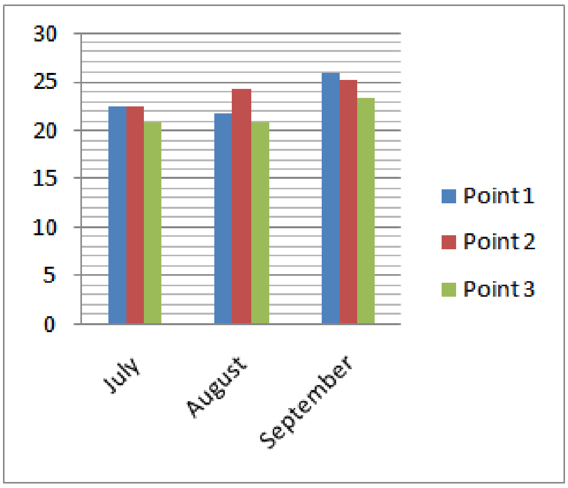

Figure 20: Mg^{2+}Concentrations

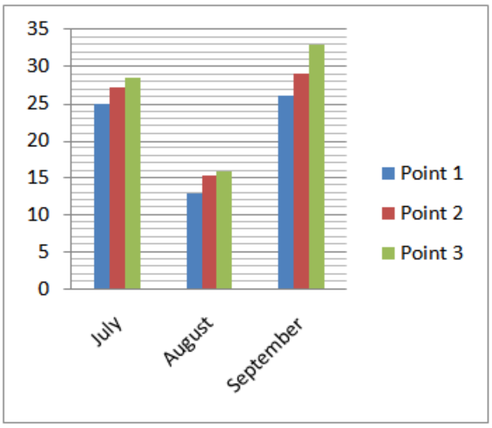

Figure 21: NO_3-Concentrations

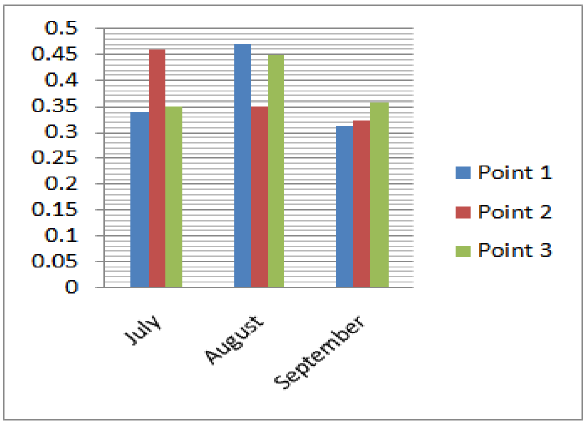

Figure 22: PO_4^{3}- Concentrations

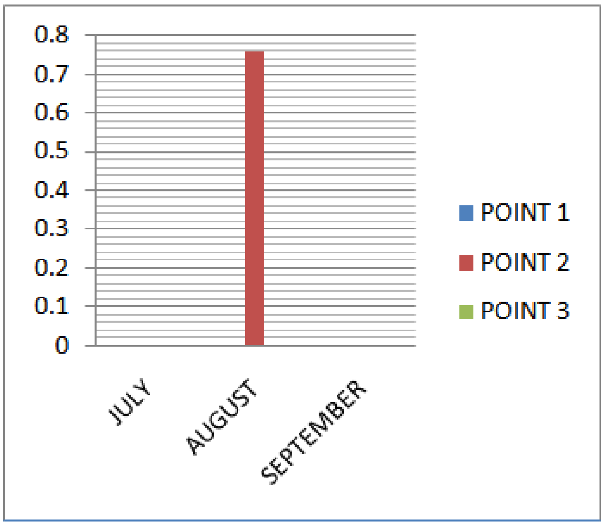

Figure 23: Mn Concentrations