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Some Sediment Physicochemical Parameters at Effluents Discharge Points of New Calabar River along Rumuolumeni Axis, Port Harcourt, Niger Delta Nigeria

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Abstract Sediments samples collected from three different discharged points (Iwofe Jetty, Minipiti and Police Post) were treated according to laboratory standards and examined for some physicochemical parameters. The sampling was done between the months of February to May. The parameters examined included pH, Conductivity, total organic carbon and total organic matter. It was observed that in all the parameters examined, that Iwofe Jetty station was more prominent than the other two stations. The results also indicated that the dry months (February and March) had more prominent values than the wet months (April and May). The differences associated with the sites may have originated from the different anthropogenic influences within the sample sites examined, and the monthly variation attributable to the effect of rain water, judging especially from the case of pH, which had higher values.

Keywords Physicochemical Parameters, sediments, effluents, pollution, Discharge points

Introduction

The dynamism of temporal superficial coastline sediments as associated with the heterogeneity of the surroundings is always followed by variations in physical, chemical and biological influences [1]. These factors can affect numerous essential developments occurring in the sediment and also the interchange of solute between the sediment and water boundary. Knowing fully well that polluted or contaminated sediments contribute majorly in the overall pollution in aquatic environments and are depositories for several and diverse organic and inorganic chemicals, and also possess the capacity to accumulate these pollutants or contaminants to levels of alarm in river environments [2]. Due to the ever increasing level of industrial growth, urban drift, improved agricultural practices, it becomes clear that the activities of man in the water course surroundings has adversely affected man, animal and plants which require certain level of purity of the environment to perform optimally. The alteration of the physicochemical nature of the environment has negative consequences on aquatic productivity and thus affect the food chain and food web of the water environment [3]. Destruction of the natural environment as a result of direct or indirect release of pollutants into the aquatic environment by humans changes the nature of the environment and so, constitute danger to plants and animals health [4].

One of the consequences of environmental contamination is reduction in fish production. This reduction arose from the impairment of water quality, which further results in habitat change, ruin, changes in the flow pattern of rivers and overexploitation [5]. The Nigerian Niger Delta is an area that is under constant exploration and exploitation for oil and so, has attracted many industries into the area. Also, the nature and pattern of live is gradually becoming more machinery based, which is accompanied with increased urban drift. This has also led to higher waste disposals and the need to build proper channels of effluents discharge in the major cities in the area. These channels are directly connected to rivers and as such, can negatively impact on the sediments as well as the water at the points of discharge [3].

This study was undertaken to examine some physicochemical properties of sediment at designated effluents discharge points into the New Calabar River, in the Rumuolumeni, area of Port Harcourt metropolis.

Materials and Methods

Sediment samples were collected from three designated discharge points (Police Post, Minipiti and Iwofe Jetty) as shown in table 1.

Table 1: Sampled points and their co-ordinate positions

Sample Points	Co-ordinate positions	Effluent sources/Activities
Iwofe Jetty	4^o 48' 32.4" N, 6^o 55" 42.7"	Homes, industries, markets, wood logging, oil bunkering, dredging, water transportation
Minipiti	4^o 41' 31.8" N, 6^o 56' 8.4" E	Homes, abattoir, University based activities
Police Post	4^o 48' 52.1" N, 6^o 56' 21.4" E	Homes, hair dressing salon

Composite samples were obtained between the months of February – May from four sample points in each of the months. The samples were placed in plastic containers and transferred to the laboratory immediately. In the laboratory, the samples were air-dried for two weeks to obtain a constant weight. The physicochemical parameters were further examined using appropriate standard methods as described in other published works. Conductivity and pH measurements of the samples was done according to the method reported in earlier works [6-7]. Total organic carbon and total organic matter followed the method described in Marcus and Edori [8]. The results were then expressed with simple mean ± Standard deviation.

Results and Discussion

The results of the physicochemical parameters in sediment samples are given in Tables 2-5 and Figures 1-4.

Sediment pH in the various stations showed that in February, the result varied from 4.28 ± 1.32 - 4.83 ± 1.11.In the month of March, the values ranged from 4.21 ± 1.01 - 4.83 ± 1.23. In April, pH values varied from 4.68 ± 1. 65 - 5.68 ± 1.81. In May, the observed values were within the range of 4.85 ± 1.27 - 6.01 ± 1.13. All the values obtained from the different stations and months indicated that the sediment samples were acidic. The values of pH obtained in this work are either lower or within the range observed in Nwaja Creek, Niger Delta, Nigeria [9]. However, they are lower than those observed in sediments of West Bengal, Bangladesh [10], the values observed in sediments of Cauvery and Kollidam River in Tiruchirappalli District, Tamil Nadu, India [11] and those observed in River Galma, Zaria, Nigeria [12].

The variation of pH within the months of examination indicated slight increase when moving into the rainy months. This slight increase resulted probably from the dilution effect of rain on the discharged effluents or frequent washing of the surface sediment due to rain water. The dissimilarity of pH is principally owing to the nature of discharged effluents at the different stations, which can be generally explained as the different nature of anthropogenic activities. Since most of the chemical reactions in aquatic environment are controlled by any change in its pH value, pH, though a simple parameter, is extremely important. Anything either highly acidic or alkaline would kill marine life. Aquatic organisms are sensitive to pH changes and biological treatment requires pH control or monitoring [13]. The pH of soil or sediment is one of the most important physicochemical parameters. It affects mineral nutrient levels, soil or sediment quality and microorganism activity [14]. The acidity or alkalinity of sediment is considered as one of the major parameters of importance because it determines the capacity of sediments to hold heavy metals and their transfer processes [15].

Table 2: Physicochemical Parameters in sediments at the different discharge points into the New Calabar River in February

Physicochemical Parameters	Stations		
	Iwofe Jetty	Minipiti	Police Post
pH	4.28± 1.32	4.69± 1.15	4.83± 1.11
Conductivity (µS/cm)	245.68± 13.44	103.76± 10.32	121.81± 10.85
TOC (%)	1.11 ± 0.12	0.77 ± 0.01	0.94 ± 0.00
TOM (%)	3.56 ± 0.69	2.31 ± 0.28	2.25 ± 0.66

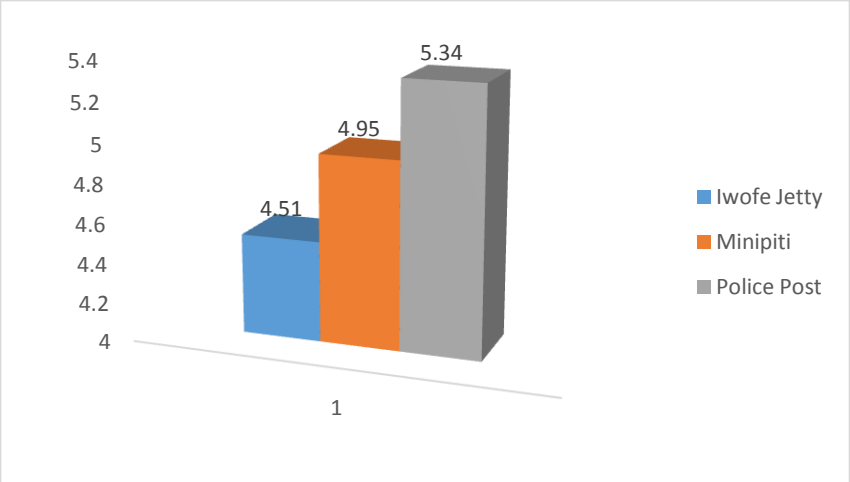

Figure 1: Mean values of pH in the stations within the months

The Electrical conductance of the sediments collected from the different effluents discharge stations in the month of February showed value range of 103.76 ± 10.32– 245.68 ± 13.44µS/cm. In the month of March, the conductivity values fall within the range of 117.05 ± 14.26 - 250.27 ± 16.54 µS/cm. In April, the observed values of conductivity varied from 01. 69 ± 11.94 - 220.67 ± 17.38µS/cm. In May, the variation observed was from 98.45 ± 12.13 - 212.43 ± 14.27µS/cm. Conductivity values in this present study were higher in the dry months than the rainy months. The measured values of conductivity in this research work corroborated the findings of Nandini and Milton [16], where they obtained value range of 120.9 ± 1.85 - 129.37 ± 3.21 µS/cm in sediment samples from Adayar Estuary, Tamil Nadu, India during pre-monsoon and monsoon seasons, but were either lower or within the same range in the values observed in sediments of Galma River, Zaria Kaduna State, Nigeria [12]. Nevertheless, the obtained values of conductivity in this work are higher than those observed in sediments from Rawal Dam Islamabad, Pakistan [17] and others observed in Sediment samples from Azuabie Creek, Port Harcourt, Niger Delta, Nigeria [18]. The conductance of any material is influenced by the concentrations of ionic species found in that substance. Such species may include the salts of Fe, Cu, K, Na, Ca, Mg, Mn, etc., which in turn reveals the hardness and salinity of the sediment [19]. The maximum value of conductivity was observed at the Iwofe Jetty station and this might be connected not only to the effluent discharges, but also other numerous anthropogenic activities taking place there.

Table 3: Physicochemical Parameters in sediments at the different discharge points into the New Calabar River in March

Physicochemical Parameters	**Stations**		
	Iwofe Jetty	**Minipiti**	**Police Post**
pH	4.21± 1.01	4.55± 1.00	4.83 ± 1.23
Conductivity (µS/cm)	250.27 ± 16.54	117.05 ± 14.26	128. 39 ± 12.96
TOC (mg/L)	2.18 ± 0.54	1.04 ± 0.11	1.10 ± 0.55
TOM (mg/L)	4.13± 1.38	2.98 ±1.04	2.34 ± 0.45

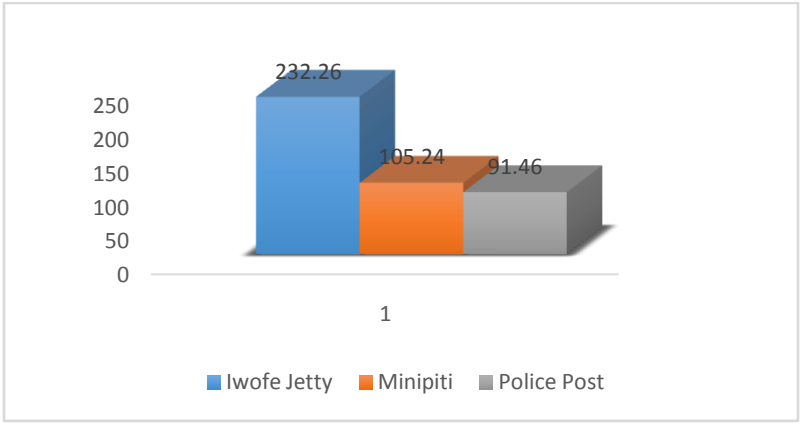

Figure 2: Mean values of Electrical conductivity in the stations within the Months

The total organic carbon (TOC) content observed in the present study showed that in the month of February, the values ranged from 0.77 ± 0.01 - 1.11 ± 0.12%. In March, the observed range fell within the values of 1.04 ± 0.11 - 2.18 ± 0.54%. In April, it varied from0.88 ± 0.23 - 1.13 ± 0.37%, while in May, the values were within the range of 0.87 ± 0.13 - 1.01 ± 0.04%. The values of TOC observed in the present work from the different stations were lower than the values observed in sediment samples of Sediment of Adayar Estuary, Tamil Nadu, India [16], but were within the range of values observed in sediments during the spring period in parts off bay Bengal, Bangladesh [10].
The observed values of TOC were highest at the Iwofe Jetty station. This apart from the other factors may have arisen as a result of numerous activities at this station. According to Kamaruzzaman et al., [20], organic carbon accumulation in sediment concentrates more at the mixing point where there is high level of process flocculation. Another factor responsible for high level of total organic carbon in any environment (aquatic or terrestrial) is a consequence of the input sources from which the discharged effluents originated. High TOC in any environment is associated with the level of organic matter discharged into the environment [20]. Furthermore, high TOC in sediment is a function of the nature (size of grains) of the particles, since finer particles have greater tendency to retain more Organic Carbon [21-22] and the surface adherence characteristics of the sediment or the sorption kinetics of organic matter to the sediment surface [23].
In this study, the presence of high concentrations on TOC in the sediments samples may have resulted from delay in the removal of the effluents at the discharge points during low tide and the contact time between the effluents and the sediment, which gave room for longer adsorption and interaction between them (effluents and sediment surface).

Table 4: Physicochemical Parameters in sediments at the different discharge points into the New Calabar River in April

Physicochemical Parameters	Stations		
	Iwofe Jetty	**Minipiti**	**Police Post**
pH	4.68 ± 1.65	5.01± 1.54	5.68 ±1.81
Conductivity (µS/cm)	220.67 ± 17.38	101. 69 ± 11.94	111.26 ± 15.82
TOC (mg/L)	1.13 ± 0.37	0.91± 0.06	0.88 ± 0.23
TOM (mg/L)	3.06 ± 0.49	2.11 ± 0.82	2.16 ± 0.27

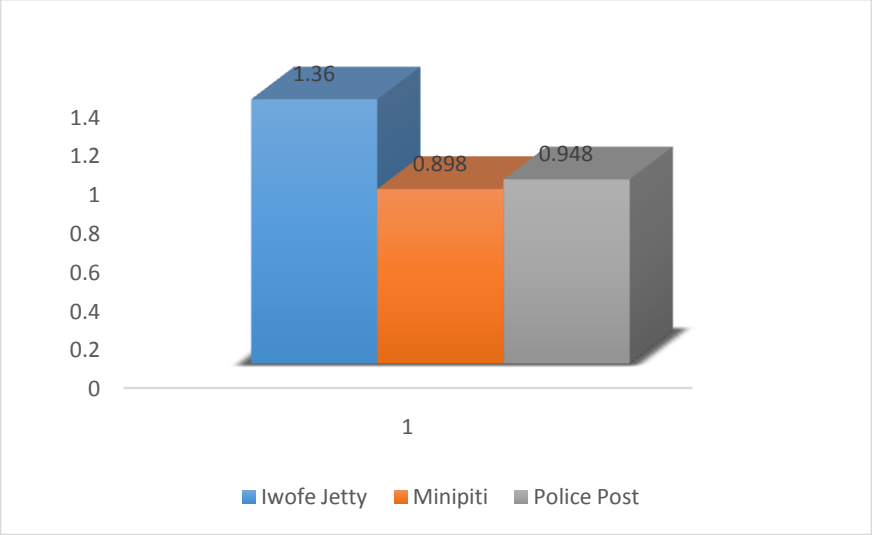

Figure 3: Mean values of total organic carbon in the stations within the months

The value of total organic matter (TOM) at the effluents discharge points in the month of February showed a variation of 2.25 ± 0.66 - 3.56 ± 0.69%. In the month of March, the values obtained ranged from 2.34 ± 0.45 - 4.13± 1.38%. In April, the values ranged from 2.11 ± 0.82 - 3.06 ± 0.49%. In the month of May the variation ranged from 2.01 ± 0.06 – 3.65 ± 1.03%.The values of TOM in the study were higher in the dry months than the wet months. The TOM content of the study area were lower than the values obtained in surface sediments of Ubatuba Bay in South Eastern Brazil [24] and those observed in sediments of the Strait of Hormoz, in the Persian Gulf [25].

The concentration of organic matter in any sediment media is a function of the percentage of silt and clay content of the sediment. This is based on the fact that the finer the sediment particles, the availability of more surface area for adherence of organic matter when compared to larger particles which offer fewer adsorption sites for complexation of colloids and organic particles. When deposited, the complexes then attract, incorporate and retain organic matter into the sediment [24].

Table 5: Physicochemical Parameters in sediments at the different discharge points into the New Calabar River in May

Physicochemical Parameters	Stations		
	Iwofe Jetty	**Minipiti**	**Police Post**
pH	4.85 ± 1.27	5.54 ± 0.86	6.01 ± 1.13
Conductivity (µS/cm)	212.43 ± 14.27	98.45 ± 12.13	104.39 ± 15.46
TOC (mg/L)	1.01 ± 0.04	0.87 ± 0.13	0. 87 ± 0.21
TOM (mg/L)	3.65 ± 1.03	2.01 ± 0.06	2.31 ± 1.63

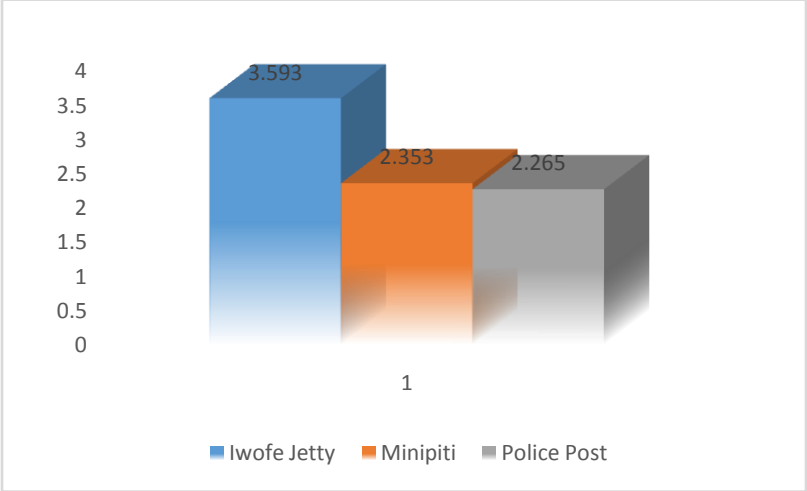

Figure 4: Mean values of total organic matter in the stations within the Months

Conclusion

The present study revealed the impact of effluents on sediment at the point of discharge into the New Calabar River. The results obtained showed that the effluents negatively affected the environment, and this may have been caused by anthropogenic activities (industrial or domestic) that have the potentials to bring about certain changes to the environment. The values observed at the different stations also indicated that the Iwofe jetty point was mostly affected by all the parameters examined, followed by those obtained at the Police and finally, at the Minipiti station. To effectively manage the ecosystem, there is the need to constantly monitor the input sources of wastes. This will help to preserve and protect the integrity of the ecosystem to enable normal aquatic life to be secured.

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