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PHYSICO-CHEMICAL CHARACTERISTICS AND WATER QUALITY ASSESSMENT FROM KURAMO LAGOON, LAGOS, NIGERIA

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ABSTRACT
A study was carried out on the assessment of the physico-chemical characteristics of Kuramo Lagoon in Lagos state. During the study period however, Weekly changes in physical and chemical water parameters from Kuramo Lagoon were investigated between two hydrological cycles for a period of 6months from February to July and analyzed. Variations in Water Temperature, Transparency, Turbidity, Dissolved oxygen, pH, Depth, Conductivity, Turbidity and Salinity were observed. The relationship between conductivity and salinity, transparency and turbidity, dissolved oxygen and Depth were also observed. Conductivity increases with increase in salinity. In most practical water quality application, the change of conductivity is dominated by temperature. The increase in conductivity in each sampling station is proportionate to increase in salinity. Kuramo Lagoon derives total dissolved solid from influx from Lagos Lagoon and river tributaries. The higher the turbidity the lower the transparency and vice versa, but around sampling station 4, the turbidity in this region is higher than other, this is because the sampling station has a shallow depth than other sampling station and there are lots of dead organic matter and inorganic materials that are lurked around the region. The oxygen concentrations are inversely proportional to depth. In shallow water, the bulk of the loss is attributable to oxidation generally occurs at the sediment/water interface where bacterial activity and organic matter are concentrated. All parameters were above permissible limits. The results shows that the Kuramo lagoon is polluted and is not fit for Domestic use and pisciculture, however, some species of fish were found in the Lagoon, this is an indication of long time adaptation to the polluted aquatic environment, and such aquatic animal could be used as bio-indicator/bio-monitor for further study on aquatic pollution.

KEYWORDS: Physico-Chemical Parameters, Bio-indicator, pollution.

INTRODUCTION

The increase in the population of man and the activities of industries around the coastal environment is greatly affecting the neutrality of the water system (FGN 1988). Growing populations may put stresses on natural waters by impairing both the quality of the water and the hydrological budget. Meybeck *et al.* (1989) reported that the amount of Pristine waters are rapidly decreasing and when considering long-range atmospheric pollutants, which have now reached polar regions and the Amazon basin, it can be said that Pristine waters no longer exist. Lagoon pollution has been increasingly significant over the recent years and this has been found to contribute significantly to environmental problems in many developing countries therefore, a measurable water quality is very essential before any meaningful level of pollution can be determined and controlled in such developing countries. Water pollution is a major problem in the global context. The primary sources of water pollution are grouped into two categories on the basis of their point of origin. The categories are; Point and non-point sources (Wikipedia, 2008). Point sources discharge pollutants (substances or matter that cause pollution) at specific locations through pipelines or sewers into the surface water, while non-point sources are those ones that cannot be traced to a single site of discharge (Lenntech, 1998, Berka *et al.,* 2001). Examples of point sources include; factories and sewage treatment plants, while those of non-point sources include: run-off from farms and fuel discharge from motorized canoes. Contaminants that pollute water include; pathogens, particulate (suspended) matter sewage and chemicals. Chemical pollution is a common type of water pollution. It is the contamination of water by chemical substances. Such activities include agricultural and industrial work which involve the use of chemicals that run-off into water and pollute it. Contamination of aquatic environment by heavy metals whether as a result of acute or chronic events constitutes additional source of stress to aquatic organisms (Kori-Siakpere et al, 2008, James *et al*., 2003). When water PH falls, metal solubility increases and the metal particle becomes more mobile. That is the reason why metals are more toxic in soft water. Both localized (point source) and dispersed (non-point source) metal pollution causes environmental damage because metals are non-biodegradable (Lenntech, 1998, Adeniyi and Ovie 1982). Water quality parameters give background information about the nature of water and this requires high technical skill to determine. Quality of water is best assessed by its Physical, Chemical and Biological Characteristics (APHA, 1989), and the process by which samples are obtained may greatly influence the results of the entire determination of the real status of the nature of the water samples if the procedures for collection are circumvent. The physico-chemical characteristics of any aquatic ecosystem and the nature and distribution of its biota are directly related to and influenced by each other and controlled by a multiplicity of natural regulatory mechanisms. However, because of man's exploitation of the water resources, the normal dynamic balance in the aquatic ecosystem is continuously disturbed, and often results in each dramatic response as depletion of fauna and flora, fish kill, change in physico-chemical character etc. Artificial changes which lead to such ecological responses are referred to as pollution and pollution stage may reach a stage when these valuable aquatic resources are no longer safe for human use. However, the main focus of water quality assessment from Kuramo Lagoon is to monitor the trends in the level of pollution using water quality indices over two hydrological cycles. One of the key factors that are considered paramount in the water pollution assessment is the temperature because of the roles it plays in physical, chemical and biological transformations in the water bodies. In the tropics where the average water temperature lies between 21^{o}c and 29^{o}c in wet seasons, large volume of the hot water draining into it will raise the temperature considerably this will stimulate bringing to the surface the nutrients present in the deep water. This will in turn increase plant growth in the water and reduces dissolved atmospheric gases in the water bodies (Olorunda et,al). Richard and Ivanildo 1997, reported that the climate which affects the quality and quantity of the country's water resources, results from the influence of two main wind system; the moist, relatively cool, monsoon wind which blows from the south-west across the Atlantic ocean towards the country and brings rainfall, and the hot dry dust-laden Harmattan wind which blows from the North-East across the Sahara desert with its accompanying dry weather and dust-laden air. The mean temperature is generally between 25^{o}c and 30^{o}c, although because of the moderating influence of the sea the mean daily and annual maximum temperature increase from the coast towards the interior. In the dry season the temperatures are more extreme, ranging between 20^{o}c and 30^{o}c. In Nigeria, the coastal belt has Estuaries and Lagoon, and closely located are some major cities with examples in Lagos, Port Harcourt, Warri and Calabar. Lagos alone account for about 80% of all the industries in Nigeria (FMHE, 1983) and the highest concentration of slums and urban settlements (Achor, 1997). Many factories in Nigeria are located on the river banks and use the rivers as open sewers for their effluents, these factories presents the greatest threat to water quality. The water bodies were been used as the cheapest and convenient refuse disposal systems. This tendency has resulted in indiscriminate and excessive loading of waste matter into the aquatic systems, beyond their capacity of self purification. Normally over any short time interval in a water body not subject to human influence there is a balance, more or less between nutrient inflow and nutrient outflow.

The problem associated with the lack of good quality water in the country threatens to place the health of about 40million people at risk. (World Bank, 1990). Kuramo Lagoon, Lat 6^{0}26 6^{0}32N and Long 3^{0}18 and 3^{0}20E (Unyimadu, 2003) receive a complex mixture of domestic and industrial waste and has served as the ultimate sink for the disposal of domestic sewage. In recent times, mismanagement of surrounding areas of a water body has resulted into unprecedented nutrient enrichment of water bodies causing cultural eutrophication, which is manifested by raised tropic status, increased rate of sedimentation, loss of water storage capacity, lowered retention period and deteriorated water quality.

The magnitude of waste received by Kuramo lagoon increase during raining season most especially the solid waste from in land waters and this in turn reduces the water quality, the greater the pollution load the poorer the water quality. The fate and transport of many anthropogenic pollutants are determined by not only hydrological cycles, but also physicochemical processes. In order to mitigate the impact human societies have on natural waters, it is becoming increasingly important to implement comprehensive monitoring regimes. Monitoring water resources will quantify water quality, identify impairments, and help policy makers make land use decisions that will not only preserve natural areas, but improve the quality of life**.** This study focuses on the assessment of Kuramo lagoon water quality using physico-chemical parameters to determine its present status of pollution and compared with (Federal Environmental Protection Agency) FEPA acceptable limit.

MATERIALS AND METHODS

Water samples were collected between the morning hour 9:00hr and11:00hr from seven different sampling stations of brackish water of Kuramo Lagoon that stretches to about 2km in length and with the depth between 2 feet- 31 feet. This water body is directly opposite Atlantic Ocean and it is separated by the Bar beach. The stations were accurately located by relying on bearing and makers on the shorelines, also taken into considerations were the canals. Sterile plastic bottles were used to collect water samples from each station. The time of sampling was dictated by the two hydrological seasons, therefore two sets of samples were obtained, the first during dry season (February-April) and the other during raining season (May- July) of the year 2012. Temperature, pH, Dissolved Oxygen, Turbidity, Depth, Salinity, Conductivity and transparency were measured in situ in each sampling station using appropriate equipment.

RESULTS AND DISCUSSION

The analyses of the physical and chemical parameters of the water were carried out for six months in all sample stations. The physical and chemical parameters evaluated were pH, Dissolved Oxygen, Salinity, Transparency, Turbidity, conductivity, Temperature and Depth. These were taken in-situ during the sampling period. The monthly variation of physico-chemical parameters are presented in tables below.

Temperature

Temperature has a pronounced effect on the rate of chemical and biological processes in water; no other single factors affect development and growth of fish as much as water temperature. In the present study, the temperature ranges from 26^{o} C – 32^{0}C. The maximum temperature (32 ^{o}C) was recorded in the month of February and minimum

(26^oc) in the month of April. The Seasonal temperature taken during the period of study from Kuramo lagoon shows that the temperature was high in the month of February and begins to fall from March through July, this is as a result of high ambient temperature during dry season (February) and low ambient temperature during the raining season (July). Also run-off during raining season from inland could also be responsible for the fall in temperature of the lagoon water from February through July. Safe, (1987) observed that during summer, water temperature was high due to low water level, high temperature and clear atmosphere.

Transparency

Transparency is the degree of light penetration in water bodies. During dry season February to April the kuramo Lagoon water appear clearer (1.36cm-1.00cm) but at the onset of raining season, May through July (1.21cm to 1.84cm), the transparency drops and the degree of light penetration reduces. This is not unconnected with silt from runoff and upwelling of the lagoon water.

Turbidity

The turbidity of Kuramo Lagoon water fluctuates from 29.86 NTU to 63.57 NTU the maximum value was recorded in the month of July. This is due to human activities, decrease in the water level and presence of suspended particulate matter. Also influx of freshwater from the canal and rainfall may also be responsible for the fluctuations. Upwelling is also a factor to be considered.

pH

The mean seasonal pH of Kuramo lagoon water indicates alkaline value. The maximum pH value (10.02) was recorded in the month July and minimum pH value (8.34) in the month of April. The Alkaline value of the Kuramo lagoon water is as a result of discharge of waste water from water treatment plant of Eko Hotel and Suite that contains Gypsum and Alum into the Lagoon and also could be the soil type from which Lagoon water takes its beds. However, the reduce rate of photosynthetic activities during the months of May to July reduces the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for gradual increase in pH of Kuramo Lagoon water.

Depth

The depth of Kuramo lagoon is shallower in the month of July compare to other months during the period of study. This is as a result of sedimentation from run-offs from in-land water when rain fall through the canal to the lagoon. However, there is direct relationship between depth, temperature and dissolved oxygen, the shallower the depth, the higher the dissolved oxygen and the greater the temperature.

TABLE 1: Average Monthly reading of Physical Parameters from Kuramo Lagoon, Lagos

Month	Temperature ^oC	Transparency cm	Turbidity NTU	pH	Depth cm
Feb	32.0	1.36	29.86	8.69	4.58
Mar	30.0	1.36	33.71	8.09	5.29
April	28.10	1.00	47.57	8.34	5.00
May	27.50	1.21	56.57	9.48	6.57
June	26.99	1.71	64.14	9.57	6.57
July	25.50	1.84	63.57	10.02	10.16

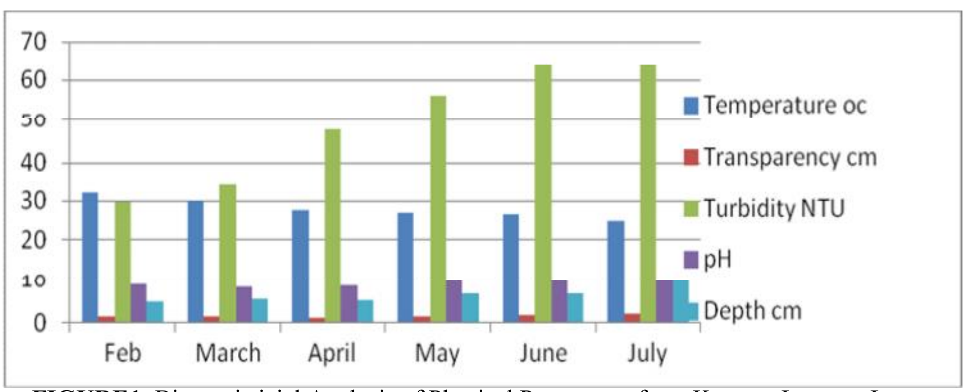

FIGURE1: Bio-statisticial Analysis of Physical Parameters from Kuramo Lagoon, Lagos

Dissolved Oxygen

During dry season, (February-April) the dissolved oxygen escaped to the atmosphere from the surface of Kuramo Lagoon water due to high temperature. Oxygen is sensitive to high temperature. During this period, aquatic plants compete for dissolved oxygen in the water for respiration although this can be gotten back as a product of photosynthesis during the day time. During the raining season however, (May-June), the dissolved oxygen in Kuramo lagoon increased as a result of dissolved atmospheric oxygen from rain water and high wind current. There is a significant relationship between dissolved oxygen and depth as it was observed in Kuramo Lagoon. The oxygen concentration is inversely proportionate to depth. In shallow sample station, the bulk of loss of dissolved oxygen is attributed to oxidation generally occurs at the sediment/water interface where bacterial activity and organic matter are concentrated. The biochemical oxygen demands were above the regulatory standard. This could be as a result of anthropogenic activities around the Kuramo Lagoon.

Conductivity/Total Dissolved Solids
The conductivity of Kuramo Lagoon water fluctuate from582u sc/cm to820u sc/cm. The maximum value (820u sc/cm) was recorded in the month of March (Dry Season) which indicates Kuramo Lagoon water dilution from rainfall and influx of freshwater from canal to the lagoon and minimum value of 582u sc/cm in the month of July.

Salinity
Salinity is the presence of soluble salts in soil and water, it is a general term used to describe the presence of elevated level of different salts such as Sodium Chloride, Magnesium and Calcium sulphates and bicarbonates in soil and water. The difference in mean values of salinity within the period of study Table 2 could be as a result of low precipitation and high rates of evaporation between February and June and high level of precipitation and low rate of evaporation in July respectively.

TABLE 2: Average Monthly reading of Chemical Parameters

Month	Conductivity u sc/cm	D.O Mg/l (x10)	Salinity % 0 (x100)
Feb	772	72.1	27
March	820	43.9	84
April	810	71.1	73
May	597	79.6	3
June	661	97.9	29
July	582	106.8	19

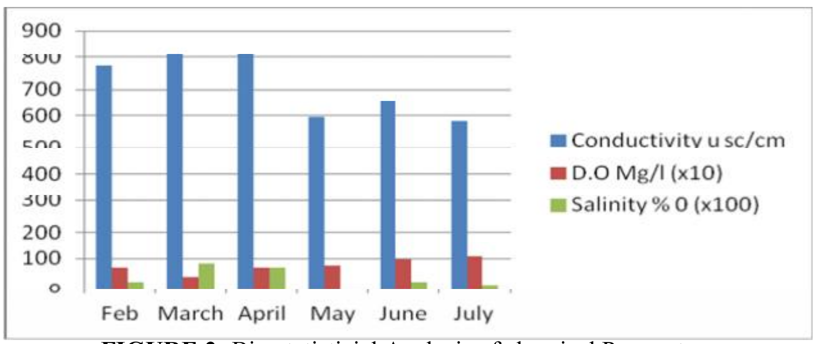

FIGURE 2: Bio-statisticial Analysis of chemical Parameters

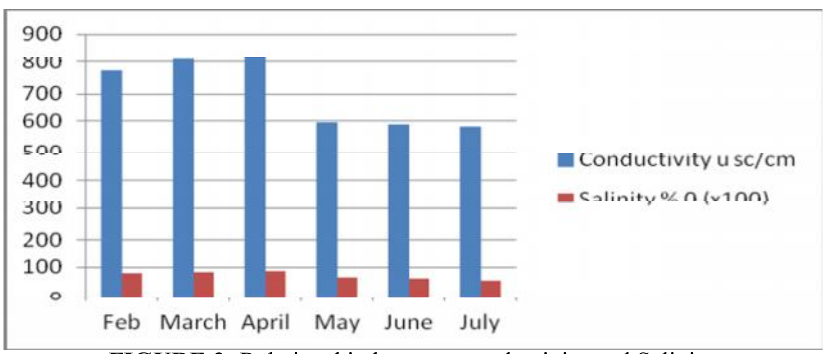

FIGURE 3: Relationship between conductivity and Salinity

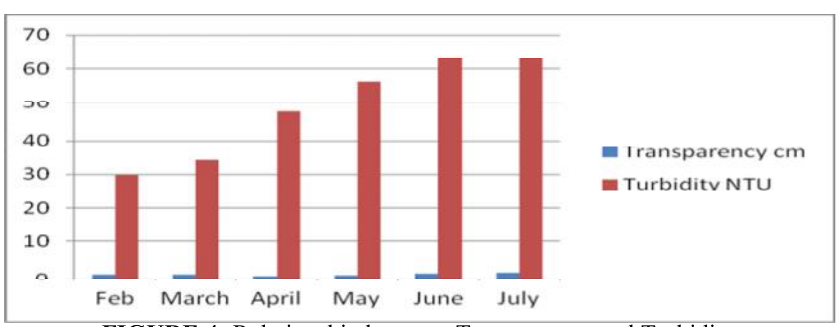

FIGURE 4: Relationship between Transparency and Turbidity

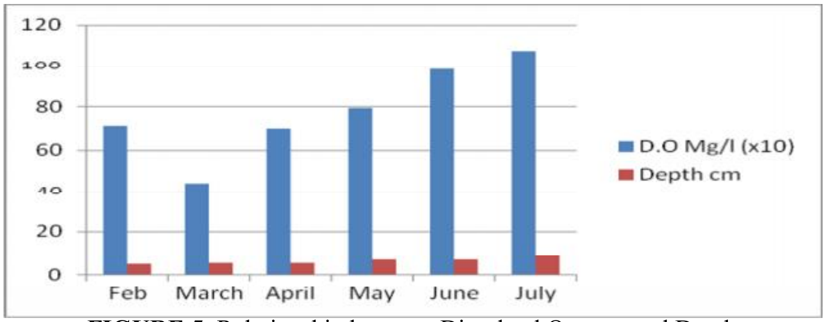

FIGURE 5: Relationship between Dissolved Oxygen and Depth

CONCLUSION

Contamination of the aquatic environment by heavy metals, whether as a consequence of chronic or toxic events constitutes additional sources of stress for aquatic organism. The results of this study show that physical and chemical Indicators of aquatic environment are factors capable of determining the level of pollution in such environment. Not all measured physical and chemical parameters and water quality variables met the acceptable criteria. FEPA (1996). The biochemical oxygen demands and conductivity values were above the regulatory standards. This could be as a result of anthropogenic activities. Allan and Flecker , (1993) Allan (1995) reported that throughout the world, rivers and stream ecosystems have been modified by human activities, possibly more than any other types of ecosystem changes in the landscape due to deforestation, drainage of wet lands and farm land grazing, water abstraction and impoundment.

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