academicJournals

Vol. 8(5), pp. 283-288, May 2014
DOI: 10.5897/AJEST2013.1638
Article Number: D491C3C45094
ISSN 1996-0794

http://www.academicjournals.org/AJEST

African Journal of Environmental Science and Technology

Full Length Research Paper

Variations in abiotic conditions of water quality of River Osun, Osun State, Nigeria

Farombi, A. G.[1]*, Adebayo, O. R.[2], Olagunju E. O.[1] and Oyekanmi A. M.[2]

[1]Science Laboratory Technology Department, Faculty of Science, Osun State Polytechnic, Iree, Osun State, Nigeria.
[2]Applied Science Department, Faculty of Science, Osun State Polytechnic, Iree, Osun State, Nigeria.

Received 22 November, 2013; Accepted 1 April, 2014

Seasonal variations in physicochemical properties of the surface water of River Osun in Osogbo, Nigeria, were investigated from May to August 2012 and November to February, 2012/2013. The water body of the mentioned river received water and wastes from the other effluences. Physicochemical parameters were determined in triplicate at three different points of the river, across the two seasons of the year. The points were named AR, BR and CR, for the rainy season and AD, BD and CD for the dry season. Samples taken from May to August represents the rainy season in the year 2012, while that of November to February 2012/2013 represents the dry season analysis. Standard methods were used in carrying out the experiments. Parameters values were gotten by the mean calculated from the triplicate determination of each sampling point. The average result determined revealed pH level of 5.87 and 6.63 for rainy and dry seasons, respectively; 137.00 and 101.33 µscm^{-1} for conductivity, 90.50 and 21.06 mg/L for total alkalinity, 2.53 and 1.77 mg/L for biochemical oxygen demand (BOD), dissolve oxygen (DO) of 3.17 and 3.97 mg/L, chloride of 10.47 and 8.20 mg/L, total hardness of 4.13 and 2.73 mg/L, chemical oxygen demand (COD) of 3.58 and 2.81, mg/L, total dissolved solids (TDS) of 62.53 and 35.43 mg/L, total suspended solid (TSS) of 25.40 and 9.30 mg/L, nitrate-nitrogen of 1.72 and 3.87 mg/L, nitrite-nitrogen of 0.23 and 0.23 mg/L and ammonia nitrogen 0.35 and 0.31 mg/L, respectively for the months of May and August 2012 and November and February 2012/2013. Heavy metal concentration were also analyzed for iron (Fe) which gave the value of 0.001 and 0.0027 mg/L, copper (Cu) 0.0010 and 0.0013. mg/L, 0.0020 mg/L and 0.002mg/L for zinc (zn) and 0.0023 and 0.0013 mg/L for nickel, all represents the two seasons, respectively. The parameters determined revealed that in most point of the river, rainy season exhibit higher values than the dry season. This could be as a result of the effluence flowing into the river body with more loads during the rainy season as compared to the dry season.

Key word: Seasonal variations, River Osun, water, physico-chemical.

INTRODUCTION

The quality and quantity of surface water in a river basin is influenced by natural factors such as rainfall, temperature, weathering of rocks and anthropogenic changes that curtail natural flow of the river, or alter its

*Corresponding author. E-mail: gladishbo@gmail.com.

hydrochemistry (Raj and Azeez, 2009).

Water quality is influenced by natural factors and human activities both of which are subject to hydrologic study (Isirimah, 2000). Industrial activities and organization in developing country including Nigeria have gradually led to the deterioration and contamination of natural environment (Agbozu and Ekweozor, 2001). Also, advancement in technology as well as increase in population has led to environment concern relative to indiscriminate dumping of refuse and discharge of industrial effluents (Wills, 2000). Quality of water generally refers to the component of water, which is to be present at optimum level for suitable growth of plants and animals. Various factors like temperature, turbidity, nutrients, hardness, alkalinity and dissolved oxygen play an important role in the growth of plants and animals in water body, on the other hand biological oxygen demand indicate the pollution level of the water body (Kamal et al., 2007). Several authors have reported that the Nigeria environment has deteriorated tremendously (Oluwande, 1974; Pickford, 1985). The natural quality of water varies from place to places with climate and geology, with stream discharge and with seasons of the year. Water quality is modified by temperature, soil bacteria, evaporation and environmental pollution and other environmental factors including live stock waste. It is desirable that industrial development brings obvious benefit; scientific evidence now claims that uncontrolled industrial and urban practice have led to unacceptable high level of harmful toxic substance in the air, pollution of rivers, lakes, coastal wastes and soil, destruction of forest and environmental hazards (UNEP, 1985).

Pollution studies on 26 rivers in some Southern and Northern state of Nigeria (Ajayi and Osibanyo, 1981), on river in Nigeria delta (Kakulu and Osibanjo, 1992), on South West Nigeria (Okoye, 1981) showed that, with the exception of iron, the concentration of most metal in the surface waters was generally lower than global average levels for surface water and the international drinking water standard.

Pollution level, be it short term or long term, reversible or irreversible, significant or insignificant and primary or secondary, must be assessed due to the harmful effect. Hence, this research work has shown the pollution level of the mentioned river water across the two seasons of the year through the determination of their physico-chemical properties and with this, the usage of the water can be determined.

MATERIALS AND METHODS

Water samples were collected from the Osun River in Osogbo, Osun State for the period of one year. Samples were collected between the months of May-August, 2013 for the rainy season samples another collection was done between November-February of the same year for the dry season samples. Sampling locations were selected along the Osun River and the points of the collection were named A, B and C. point A is the entrance of the town, point B is the heart of the town while point C is the ending of the town. The sample collected were named AR, BR, CR and AD, Bd, CD, for the rainy and dry season for each point, respectively. The samples were collected at a depth of about 15 cm in clean white polyethylene cans by dipping the cans into the river, immediately after collection, the samples were carefully stoppered to avoid contact with the air.

The parameters such as pH, conductivity and dissolved oxygen were recorded immediately on the field. Other parameters such as Biochemical oxygen demand, chemical oxygen demand, alkalinity, total hardness, chloride were analyzed in the laboratory, using standard method (APHA, 1992). The experiments were conducted in triplicate for each points of collection and the average was gotten.

RESULTS AND DISCUSSION

From the Tables 1 and 2, and Figures 1 and 2 the pH value for the rainy season at point AR, BR and CR were 5.60, 6.00 and 6.00, respectively, while that of dry season for point AD, BD and CD were 6.50, 6.80 and 6.60, respectively. These recorded values for rainy season are below the ambient water quality criteria recommend by both national and international bodies (6.5-8.50) (FEPA, 1991; WHO, 1984). The slightly acidic nature may have resulted from the effluence flowing into the river during the rainy seasons. This correlates with the fact that acidity in fresh water result from products of many complex processes such as erosion from lateritic soil etc. (Organ, 1988). The dry season show value within the recommended criteria, which is due to lesser flow into the river during the season.

Conductivity for the rainy season at point AR, BR, and CR are 101, 170 and 140, respectively while point AD, BD and CD gave 92, 110 and 102, respectively. Conductivity values depends on total concentration of ionized substances and the temperature of the water, more dissolved solids and ions are introduced into surface bodies from municipal run off and other anthro-pogenic source during the rainy season, therefore the higher value are shown during the rainy season than the dry season. The level of conductivity recorded during both seasons is low when compared with that of FEPA (1991) and WHO (1984).

Sulphate level recorded during rainy season for point AR, BR, and CR which are 60.30, 90.10 and 90.00 respectively were lower than the ambient water quality criteria of 200 mg/L (FEPA, 1991). Dry season, show the value of 50.20, 57.60 and 56.00 for points AD, BD and CD, respectively. These are also lower than the water quality criteria. Higher value during the rainy season as compared to the dry season could be attributed to the effluents which result to increase in oxidation of sulphate from waste entering into the river.

The value of dissolved oxygen is remarkable in determining the quality criteria of an aquatic system. In the system where the rate of respiration and organic

Table 1. Physicochemical properties of River Osun water samples between the month of May and August 2012 (rainy season).

Parameter	AR	BR	CR	Average
pH	5.60	6.00	6.00	5.87
Conductivity	101	170	140	137
Total alkalinity (mg/L)	72.50	99.50	99.50	90.5
Biochemical oxygen demand (BOD) (mg/L)	2.20	2.80	2.60	2.53
Dissolved oxygen (DO) (mg/L)	3.40	3.20	2.90	3.17
Chloride (mg/L)	9.10	11.30	11.00	10.47
Total hardness (mg/L)	4.00	4.60	3.80	4.13
Chemical oxygen demand (COD) mg/L)	3.86	3.54	3.35	3.58
Total dissolved solid (TDS) mg/L)	60.10	62.20	65.30	62.53
Total suspended solid (TSS) mg/L)	22.40	25.20	28.60	25.40
Nitrate - nitrogen (mg/L)	1.35	1.84	1.96	1.72
Nitrite - nitrogen (mg/L)	0.21	0.24	0.26	0.23
Ammonia nitrogen (mg/L)	0.24	0.39	0.43	0.35

Parameter results are average of triplicate determination of each sampling point. AR = Samples collected at point A during the rainy season; BR = Samples collected at point B during the rainy season; CR = Samples collected at point C during the rainy season

Table 2. Physicochemical properties of River Osun water samples between the Month of November and February 2012/2013 (dry season).

Parameter	AD	BD	CD	Average
pH	6.50	6.80	6.60	6.63
Conductivity	92	110	102	101.33
Total alkalinity (mg/L)	20.20	21.50	21.50	21.06
Biochemical oxygen demand (BOD) (mg/L)	1.70	2.00	1.60	1.77
Dissolved oxygen (DO) (mg/L)	4.50	3.80	3.60	3.97
Chloride (mg/L)	7.50	8.60	8.50	8.2
Total hardness (mg/L)	2.70	2.90	2.60	2.73
Chemical oxygen demand (COD) mg/L)	3.16	2.90	2.36	2.81
Total dissolved solid (TDS) mg/L)	33.20	35	38.10	35.43
Total suspended solid (TSS) mg/L)	8.20	9.50	10.20	9.30
Nitrate - nitrogen (mg/L)	0.28	0.30	0.29	3.87
Nitrite -nitrogen (mg/L)	0.23	0.23	0.24	0.23
Ammonia nitrogen (mg/L)	0.21	0.32	0.39	0.31

Parameter results are average of triplicate determination of each sampling point. AD =Samples collected at point A during the dry season; BD = Samples collected at point B during the dry season; CD = Samples collected at point C during the dry season.

decomposition are high, the DO values usually remain lower than those of the system, where the rate of photosynthesis is high (Mishra et al., 2009). During the study period, DO were found to be low, Aggarwal et al. (2000) reported that in Varuna River water, the DO was observed to be decreased in point source and increased in upstream.

The DO result showed valued of 4.50, 3.80, 3.60 mg/L for AD, BD and CD, respectively. While points AR, BR and CR gave 3.40, 3.20 and 2.90 mg/L, respectively. The river waste are being oxidized by the dissolved oxygen depleting the DO in the river, thus depleting the waste slowly as the river flows and as much is exposed to the atmosphere, the DO is gradually replenished (Ademoroti, 1996).

The BOD_5 value of 2.201, 1.80 and 2.60 were shown for AR, BR, and CR respectively and 1.70, 2.00 and 1.60 were shown for AD, BD and CR respectively. The BOD_5 values recorded for the rainy season were higher than that of the dry season as this could be as a result of massive amount of waste flowing into the river during the rainy season, hence oxygen will be consumed faster by

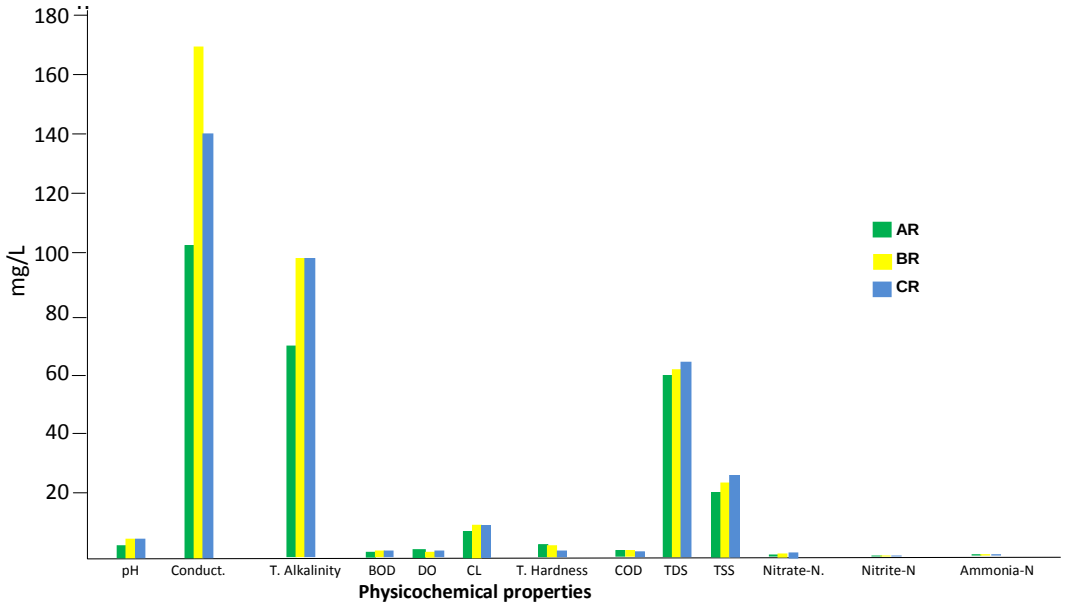

Figure 1. Phsicochemical properties of River Osun water samples between the months of May to August 2012 (rainy season).

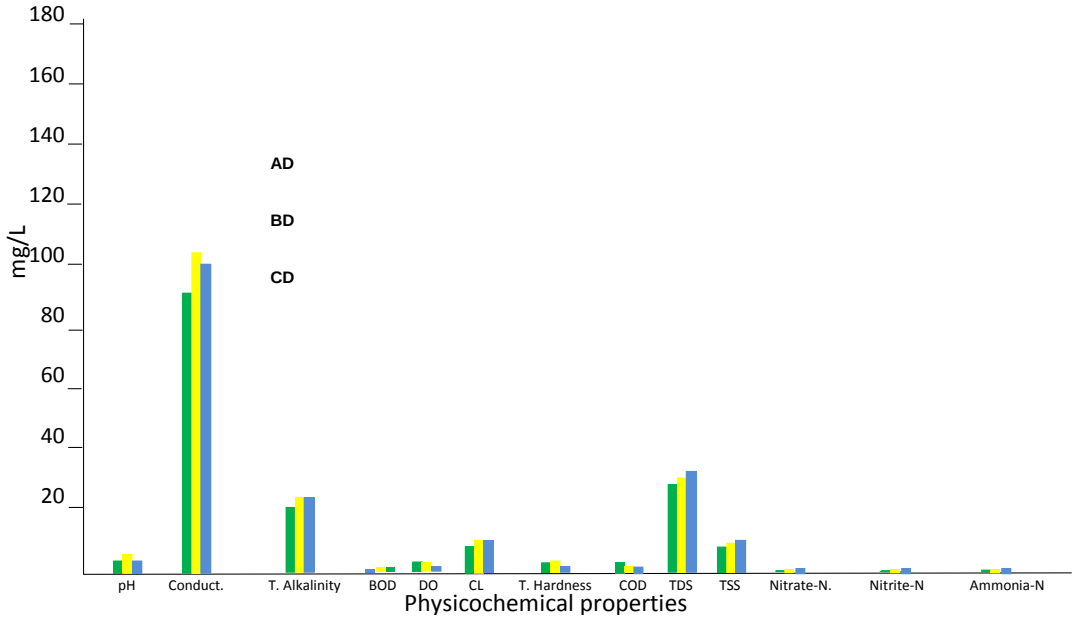

Figure 2. Phsicochemical properties of River Osun water samples between the months of November to February 2012/2013 (rainy season).

microbial population. In dry season, lesser waste found their way into the river body. The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand (Abida and Harikrishna, 2008).

The chloride content of the river was lower than theambient water quality criteria of 200 mg/L (FEPA, 1991) 9.10, 11.30 and 11.00 mg/L for AR, BR and CR respectively and 7.50, 8.60 and 8.60 mg/L for AD, BD and CD respectively. Chloride ions are introduced into the river system via sewages. The higher value during the rainy season could be attribute to an increase in the flow sewage finding their way into the river during the rainy season; chloride content in excess of 100 mg/L

Table 3. Average of heavy metals in River Osun water sample between the month of May and August 2012 (rainy season).

Heavy metal	AR	BR	CR	Average
Iron (Fe) mg/L	0.0010	0.0012	0.0008	0.0010
Zinc (Zn)	0.0023	0.0020	0.0017	0.0020
Nickel (Ni)	0.0023	0.0024	0.0022	0.0023
Copper (Cu)	0.0010	0.0010	0.0010	0.0010

Table 4. Average of heavy metals in River Osun water sample between the months of November and February 2012/2013 (dry season).

Heavy metal	AR	BR	CR	Average
Iron (Fe) mg/L	0.0025	0.0027	0.0029	0.0027
Zinc (Zn)	0.0020	0.0020	0.0020	0.0020
Nickel (Ni)	0.0015	0.0012	0.0012	0.0013
Copper (Cu)	0.0013	0.0013	0.0013	0.0013

could cause physiological damage while content greater than 40 mg/L indicate salt water contamination (Todd, 1980).

Total alkalinity of water is due to presence of mineral salt present in it. It is primarily caused by the carbonate and bicarbonate ions (Singh et al., 2010). Chlorides are disturbing in irrigation water and also harmful to aquatic life (Rajkumar et al., 2004). 72.50, 99.50 and 99.50 were recorded for AR, BR, CR total alkalinity, respectively, and 20.20, 21.50 and 21.50 for AD, BD, and CD, respectively, all the values are still within the target water range (20-100 mg/L) recommended for the health of fishes. The variation could be due to increase in sludge to the river during the rainy season and legal influence on the river system producing carbonates and hydroxides (Organ, 1988).

Hardness value gotten for the two season were below the WHO standard which is 500 mg/L and from the table AR, BR, CR gave the value of 4.00,4.60 and 3.80 mg/L, respectively while AD, BD, and CD gave 2.70, 2.90 and 2.60 mg/L, respectively. This variation in the two season value could also be due to the increase in the waste flowing into the river during the rainy season. High value of hardness during summer can be attributed to decrease in water volume and increase in rate of evaporation of water (Hujare, 2008).

The nitrate nitrogen of 1.35, 1.84 and 1.96 mg/L were gotten for AR, BR, CR recorded in surface water in this study is significantly lower than the ambient water quality criteria of 10 mg/L (FEPA, 1991). This also correlates with the observation of Organ (1988) that the concentration of nitrate phosphate and nitrate are low surface waters. No adverse effect can be observed with water body of such concentration in nitrate except mathaemoglobinemia in infants (Radojevic and Bashkin, 1999). Nitrite level recorded in their study is invariably much lower than the level of nitrate ammonia nitrogen in this study showing the value of 0.24, 0.39, and 0.43 mg/L for the AR, BR, CR and 0.21, 0.32 and 0.39 mg/L for AD, BD, CD, respectively. Fertilizer use, decayed vegetable and animal matter, sewage sludge disposal to river body is due to the flow of effluence in the rainy season easily than the dry season.

The total dissolved solid (TDS) of 60.1, 62.2 and 65.33 mg/L and 33.2, 35.1, 38.1 mg/L for the respective sample points of the river were found within the permitable limit (100 mg/l) of WHO standards. Dissolved solid comprised of salt and small amount of organic matter, the principal ions contributing to TDS are carbonate, bicarbonate, chloride, sulphate, nitrate, sodium potassium, calcium and magnesium (USEPA,1976), all these flows easily in large quantity into the river during the rainy season than dry season. All the result indicated were revealed by the APHA (1992) standard methods.

The total suspended solid gave the value of 22.4, 25.2, 28.6 mg/L and 8.2, 9.5 and 10.2 mg/L for the two seasons, respectively. Clay, salt, collochial organic particles, plankton and other microorganism are the suspended matter which was higher in the rainy season than the dry season.

As shown in Tables 3 and 4 the analyzed metals were Fe, Cu, Ni and Zu. They were present in a very minute quantity across the two seasons. The value obtained fell below the WHO recommended maximum unit of 0.3 mg/L.

Conclusion

From the result, some of the determined parameters such as conductivity and chloride content were low in value as compared to the water quality criteria, although rainy season values were a little higher than the dry season but still lower than the recommended standard. The little variation may be due to the effluence carrying waste from different sources into the river body during the rainy season. The present study concluded that river water of the study area was moderately polluted in respect of the analyzed parameter due to the fact that some analyzed parameters are within permissible limit, e.g total alkalinity and the pH which were revealed during the dry season. Higher value of BOD_5 shown during the rainy season is not suitable. Therefore, there is need for the residence to safeguard the river water.

Conflict of Interests

The author(s) have not declared any conflict of interests.

REFERENCES

Abida B, Harikrishna (2008). Study on the Quality of Water in some streams of cauvey River, E.J. Chem. 5(2):377-384.

Ademoroti CMA (1996). Environmental Chemistry and toxicology. Pg 56.march publisher and consultancy, BDPA, Ugbowo Street, Benin. Nigeria.

Agbozu IE, Ekweozor IKE **(**2001). Surface water pollution of Etelebour oil field in Bayelsa State, Nigeria. Afr. J. Sci. 24:254.

Aggarwal TR Singh KN, Gupta AK (2000). Impact of sewage containing domestic wastes and heavy metals on the chemistry of varuna river. Polut. Res. 19(13):491-494.

Ajayi SO, Osibanyo O (1981). Pollution studies on Nigeria river 2. Water quality of some Nigeria rivers. Environmental Pollution, (series B) 2:87-95.

Federal Environmental protection Agency (FEPA) (1991). National Interim Guideline and standard for environmental pollution control in Nigeria, pp. 54-58.

Hujare MS (2008). Seasonal variation of physico-chemial parameters in the perennial tank of Talsande, Maharashtra. Ecotoxicol. Environ. Monit. (18)13:233-242.

Isirimah NO (2000). Soils and Environmental pollution Management. Nichdano Publisher, owerri, Nigeria.

Kakulu SE, Osibanjo O (1992). Pollution studies on Nigeria rivers. Trace metals levels of surface water in the Niger Delta area Int. J. Environ. Studies 41:287-292.

Kamal D, Khan AN, Rahaman MA, Ahamed F (2007). Study on the physic chemical properties of water of Mouri River, Khulna, Bangladesh. Pak. J. Biol. Sci. 10 (5):710-717.

Mishra A, Mukherjee A, Tripathi BD (2009). Seasonal and Temporal Variation in Physico-Chemical and Bacteriological Characteristics of River Ganga in Varansi. Int. J. Environ. Res. 3(3):395-402.

Okoye BCO (1981). Heavy metal in Lagos. Int. J. Environ. Studies, 37:285-292.

Oluwande PA (1974). Investigation of certain Aspect of Refuse in Western State of Nigeria. J. Solid Waste Manage. pp. 164-222.

Organ MT (1988). Examination of Surface water used as sources of supply in the port Harcourt Area II, (chemical Hydrology-Arch-Hydrobiol.Suppl; 79) 2/3:325-342.

Pickford J (1985). The solid wastes problems of poor people in the third world cities: in Itolmes, J (ed). Practical waste management J. Wiky, UK: p. 485.

Radojevic M, Bashkin VN (1999). Practical Environmental Analysis Royal Society of Cambridge.

Raj N, Azeez PA (2009). Spatial and temporal variation in surface water chemistry of a tropical river, the river Bharathapuzha, india. Curr. Sci. 96:2.

Rajkumar S, Velmurugan P, Shanthi K, Ayyasamy PM, Lakshamanaperumalasamy P (2004). Water Quality of Kodaikanal lake, Tamilnadu in Relation to Physico-Chemical and Bacteriological Characteristics, Capital Publishing Company, Lake. pp. 339-346.

Singh MR, Gupta A, Beeteswari KH (2010). Physico-chemical properties of water samples from manipur river system, india. J. Appl. Sci. Environ. Manage. 14(4):85-89.

Todd DK (1980). Groundwater Hydrogeology 2nd, John widely & son, NV, pp. 267315.

UNEP (1985). Reference trethod for marine pollutions studies. pp. 32-39.

USEPA (1976). Quality criteria for water. United State Environmental studies agency Washington DC.

W.H.O (1984). Guidelines for drinking water quality.Vol.2 Health Criteria and supporting information. Geneva.

Wills JA (2000). Survey of offshore oil field drilling wastes and disposal techniques to reduce the ecological impact of sea dumping. Sakhalin Environ. Watch 13:23-29.