Journal of Engineering and Applied Sciences 7 (8-12): 490-493, 2012
ISSN: 1816-949X

Assessment of Quality and Supply of Ede Water Supply Network, Osun State, Nigeria

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Abstract: Water quality is closely linked to vulnerability of water sources to pollution potentials and the level of treatment processes involved. The study examined the assessment of water quality and supply of Ede Water Supply Network and assessed the physico-chemical and bacteriological quality of the water by comparing it to the existing national and international guidelines and standards for potable water. This was with a view to providing some necessary baseline data for assessing public water supply quality. Water samples were collected from 9 sampling stations (3 on the dam point, 3 on the treated point and 3 on the tap point along the pipe network). The samples were analyzed for general physico-chemical parameters (temperature, colour, conductivity, total suspended solid, total solid, turbidity, total alkalinity, total acidity, pH, total hardness), major ions (Cd, Pb, Na, K,Cu, NO_3^-, PO_4^{3-}, and SO_4^{2-}), oxygen parameters: BOD and COD and biological parameters (total coliform, *E. coli*, faecal coliform, total heterotrophic bacteria and total heterotrophic fungi) using standard analytical methods. The results showed that most of the investigated physical parameters and major ions were all significantly higher in dam point than treated and tap points. Most of the parameters were generally higher at the treated point than at the tap point. The concentrations of most of the investigated ions in the water samples from Ede Water Supply Network were within the permissible limits of the World Health Organization (WHO) and Nigerian Industrial Standards drinking water quality guidelines. The results showed that biological parameters of the treated and tap points were within limits of the World Health Organization (WHO) and Nigerian Industrial Standard but was higher at the dam point. In conclusion, the water quality of the Ede Water Supply Network is within to the World Health Organization guidelines and standards for drinking water supply and the government needs to do more in the aspect of adequate strengthening of the water supply distribution appurtenances to the consumers.

Key words: Water availability, supply network, water quality, assessment, *E. coli*

INTRODUCTION

Water quality is closely linked to water use and to the state of economic development. The vulnerability of surface water and ground water to degradation depends on a combination of natural landscape features, such as; geology, topography and soil type and anthropogenic activities. Water quality has been heavily impacted world wide by industrial and agricultural chemicals (Terry, 1996). Pollution is caused by washing into surface water sewage and fertilizers which contain nutrients such as nitrates and phosphates which when present in excess stimulate the growth of aquatic plants and algae that consequently clog watercourse and use up dissolved oxygen as they decompose (Adenuga *et al*., 2003).

Water is crucial to living. Access to water and sanitation is both a right and a requirement for reducing poverty and a driver of growth (O'Connell, 2003). If the food needs of the global population are to be met, there must be adequate access to water for irrigation by farmers not only for Urban Agriculture (UA) but for the rural areas where the bulk of the food is produced. Most of the environment and public health hazards, including those traceable to consumption of unwholesome foods and beverages, are traceable to inadequate and poor quality of water consumed or used by both human beings and animals and to lack of adequate sanitation facilities (Adewumi, 2010).

Water is a basic requirement for life and when the resource is to be used for domestic purposes, it should meet some set standards. These standards include biological settings such as microbial population and chemical parameters such as cations and anions. Others are physical properties, including; true colour, taste, turbidity, pH, temperature, electrical conductivity and total alkalinity. Whenever, the threshold for the parameters set by bodies such as World Health Organization (WHO) is exceeded, the water is said to be

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polluted. The main source of water for domestic purpose in the municipality includes surface water, well/bore water and treated water that may be distributed through pipes, bottles and sachets (Amorin and Asamoah, 2011).

The availability of safe drinking water in suitable quantity has been a major problem in both urban and rural areas in major towns in Osun State. Water supply quality is affected by the lack of insufficient treatment processes and inadequate quantity of water. In the recent past, in major towns in Osun State including Ede, there have been records of cases of cholera and typhoid fever. In view of this, it is important to evaluate the quality of the Ede water supply works with a view to determining its potability; the physico-chemical and bacteriological quality of the water and examine the quality of the water in relation to the existing standards.

The study area: The study was carried out on the Ede reservoir, its outflow stream (River Shasha) as well as the associated public water distribution system in Ede, Osun State, Nigeria. Ede is a semi-urban city and consists of two Local Government Areas (LGAs), namely: Ede North Local Government Area and Ede South local government. The population of Ede is 159,866 persons (FGN, 2009) with a project annual growth rate of 2.8%. Ede, approximately, is between latitudes latitude 7°31' and 7°55' North and longitude 4°15' and 4°40' East. Climatically, the town is marked by double maximum rainfall of 1196 mm and maximum in July and September. The town is the transitional zone between the tropical rain forest and the savannah region and its soils have impeded drainage due to the presence of 2:1 clay minerals (Hydromorphic) (Gasu, 2011). The study area has agrarian economy with savannah grassland (Okusami, 2011).

MATERIALS AND METHODS

The design of the study was done to be the point collection of the samples of water at the reservoi at the level of the treated water in the reservoir treatment and at the point of distribution to the consumers on the same day. Water samples were collected from 9 sampling stations (3 on the dam point, 3 on the treated point and 3 on the tap point along the pipe network from the dam). The choice of sampling station took into note; the location, accessibility to human residences and the distribution of the pipe network into neighborhoods. At the sampling stations in the Ede water works, water samples were collected using clean and labeled polythene plastic containers/sterile McCartney bottle. Clear reagent bottles that were adequately labeled were used to collect treated water directly from the tap. The samples were taken to the laboratory for analysis within 6 h of taking them at the sampling points for biological analysis while the samples for physico-chemical analysis were taken to the laboratory, stored within 14 days for the analysis.

The physical analysis of the properties of the water samples taken, namely; total suspended solids, total solids, turbidity, colour and temperature were done in compliance with the procedures stipulated by APHA (1998). The analysis of the chemical constituents of the samples pH, total alkalinity, total hardness, total acidity; the presence of the heavy metals (Cd, Pb, Cu), NO_3^-, PO_3^{4-}, SO_4^{2-}, Na, K were carried out in line with APHA (1998) and the determination of BOD and COD were carried out in line APHA (1998) and Ademoroti (1982). The biological analysis of the samples, total coliform, *E. coli*, faecal coliform, total heterotrophic bacteria and total heterotrophic fungi were carried out according to APHA (1998). The results of the analyses were compared with the standards set by the WHO (1997) and NIS (2008).

RESULTS AND DISCUSSION

The results of the physical analysis of the samples show that the mean value of temperature of water at the tap point was 29.7°C compared to 33.33°C had in samples collected from the dam point and treated point of the dam. This is at variation to the ambient temperature specified by the Nigerian Industrial Standards that potable water should have. The mean values of other physical properties of the water samples taken at the dam, treated point in the dam and at the tap point were at variant with the values specified by the World Health Organization (WHO) and the Nigerian Industrial Standards (NIS) (Table 1). The mean values of the chemical properties of the samples taken at the dam point were more than what obtained at the treated point in the dam and the mean values gotten at the tap point were within the ranges set by the World Health Organization and the Nigerian Industrial Standard (Table 2). The same trend was observed in the mean values of the biological properties

Table 1: Mean values of the physical properties of the samples compared with NIS and WHO Standards

	Sample location				
Parameters	Dam point	Treated point	Tap point	NIS Standard	WHO Standard
Temperature (°C)	30.33	30.33	29.7	Ambient	-
Conductivity (mg L^{-1})	140.67	96	86.67	1000	-
Total suspended solid (mg L^{-1})	204.33	198.67	158	500	-
Total solid (mg L^{-1})	339.33	271	238	500	-
Turbidity (NTU)	18	8.67	8.67	5	5

Table 2: Mean values of the chemical properties of the samples compared with NIS and WHO Standards

	Sample location				
Parameters	Dam point	Treated point	Tap point	NIS Standard	WHO Standard
pH	7.07	6.60	6.80	6.50-8.50	6.50-8.50
Total alkalinity (mg L^{-1})	45	26	16.67	200	-
Total hardness (mg L^{-1})	21.33	13.33	10.67	100	500
Total acidity (mg L^{-1})	20	20.67	20	-	
Cadmium (mg L^{-1})	0.011±0.003	0.003±0.002	0.002±0.001	0.003	0.05
Lead (mg L^{-1})	0.005±0.002	0.002±0.001	0.005±0.002	0.01	0.01
Sodium (mg L^{-1})	2.06±0.040	1.056±0.022	1.063±0.023	200	200
Potassium (mg L^{-1})	1.050±0.036	0.561±0.020	0.338±0.014	-	-
Copper (mg L^{-1})	0.955±0.020	0.100±0.004	0.026±0.002	1	-
Nitrate (mg L^{-1})	286.4	92	73.77	10	10
Phosphate (mg L^{-1})	4.7	2.1	1.92	-	2.5
Sulpahte (mg L^{-1})	407.83	162.37	96.57	100	400
BOD (mg L^{-1})	9.33	12.00	5.53	-	-
COD (mg L^{-1})	12.67	11.33	6.00	-	-

Table 3: Mean values of the biological properties of the samples compared with NIS and WHO Standards

	Sample location				
Parameters	Dam point	Treated point	Tap point	NIS Standard	WHO Standard
Total coliforms (MPN mL^{-1})	180	29.67	1.33	100	0
E. coli (CFU mL^{-1})	46	26.67	-	-	0
Faecal coliform (CFU mL^{-1})	Cluster	22.67	-	-	0
Total heterotrophic bacteria (CFU mL^{-1})	49.67	30.00	-	-	0
Total heterotrophic fungi (CFU mL^{-1})	-	-	-	-	-

of the samples taken in the three different points. The mean values of the samples at the tap point were within the range specified by the World Health Organization and the Nigerian Industrial Standards (Table 3).

The results obtained for the physico-chemical constituents of Ede water supply is attributed to the concentration of dissolved constituent through evaporation. The low concentration of the total hardness is as a result of calcium and magnesium ions dissolved in the water. The water of the study area is classified as soft and therefore good for domestic purposes. The measure of total dissolved solids is a good indicator of the mineralized character of the water. The low concentration of the total hardness is as a result of calcium and magnesium ions dissolved in the water. The water of the study area is classified as soft and therefore good for domestic purposes.

The chemical constituents of water depend on the source, movement and environment of the water. Primarily, soluble salts found in water originate from solution of rock materials. The more common soluble constituents include calcium, sodium, bicarbonate and sulphate ions. The dam has a very high concentration of sodium ion which is largely attributed to the presence of plagioclase feldspar. The concentration of chloride in the water is low compared to other anions. The content of the chlorides may be from the soluble chlorides from rocks in the area or rainfall. The concentration of nitrate ion in the water of the study area suggests maximum pollution from pit latrines and its concentration could also result from nitrogen fixing fertilizers from farmlands surrounding the area. An important source of sulphate in water is the oxidation of pyrite (ferrous sulphide) which is widely distributed in sedimentary rocks and the level of sulphate at the dam point is far more than the value obtained at the other sampling points but the treated water has values that falls within the limits sets by the World Health Organization and the Nigerian Industrial Standards (NIS).

The occurrence of cation, such as; copper, potassium, lead, sodium and cadmium in drinking water is not regarded to be of toxicological significance, particularly at low concentration levels of 0.01-3.0 mg L^{-1} recommended by WHO. Trace elements concentrations in the water with copper being the most concentrated are likely due to the acidic conditions under which the water exists. Generally, from the above discussion, the chemical standard set by WHO indicates that the Ede water supply meets the necessary requirement for domestic usage and it establishes that the physical quality of the groundwater is good for drinking, irrigation purposes and other suitable purposes.

CONCLUSION

The study has shown that most of the investigated physical parameters and major ions were all significantly higher in dam point than treated and tap points. Most of the parameters were generally higher at the treated point than at the tap point. The concentrations of most of the investigated ions in the water samples from Ede Water Supply Network were within the permissible limits of the World Health Organization (WHO) and Nigerian industrial standards drinking water quality guidelines. The results showed that biological parameters of the treated and tap points were within limits of the World Health Organization (WHO) and Nigerian Industrial Standard but was higher

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