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Assessing Suitability of Constructed Model Treatment Plant in Treating River And Pond Water For Domestic Purposes Maiduguri, Nigeria

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Abstract: In this study, Physico-chemical and biological analysis of river Ngadda and pond water collected in Ramat Polytechnic ware evaluated to compare their compliance with World Health Organisation (WHO) using standard analytical methods. The parameters evaluated include: K, Mg, Mn, NO_3, Iron, PO_4, and hardness pH, Cl, K, Ca, EC, OD, BOD, TDS, Mg, Mn, NO3, PO4, Iron and coliform counts. The results from the laboratory analysis showed some of the physico-chemical parameters conform with WHO except K, Mg, Mn, NO_3, Iron, PO_4, and hardness that were found to be above the WHO standard. Coliform count was found to be present in the water that exceed the WHO standard. The t-test result reveals that there is no significant difference between the river and pond water properties with the WHO standard. The results of this study indicate that model water treatment plant could be suitable for treating water for domestic purposes.

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INTRODUCTION

Water is one of the most important substances needed by human, animals and plants for their day to day activities and survival. It is an important component of rural and urban environments and management of this proponent is the key to ensuring a better and quality environment (Olusheyi et al., 2016). Water is one of the most important natural resources useful for developmental purposes in both urban and rural areas. It is vital to our existence in life therefore thorough physico-chemical examinations are conducted on surface and underground water (Babatunde and Umahi, 2014). Most of the rural communities in the developing countries lack access to potable water supply. They rely commonly on rivers, streams, wells and ponds for daily domestic purpose (WHO, 2000). The prevailing lack of infrastructures in the rural areas of Nigeria has made water from the streams and rivers the major source through which the inhabitants in these areas get water (Siyanbola *et al.*, 2011, Madumere, 2012). The impact of the activities of man has been so widespread that the water bodies have lost their self-purification capability to a large extent (Sood *et al*., 2008; Anyanwu, 2012, Ranjini *et al*., 2010). The control of water quality has become very important in maintaining the sustainability of water resources (Othaman, 2015). The World Health Organization therefore has recommended continuous surveillance of water supplies, which should involve monitoring of the water supplies, from public health point of view, for safety and the ability to sustain water supplies. This is to be achieved through sanitary inspection and water quality analysis (World Health Organization, 2002, *Drinking Water Guidelines; Bacteriological Parameters*. The quality and purity forms of these sources are very uncertain. The quality of natural water is generally governed by various physico-chemical and microbiological parameters. The study intends to carry out the physical and chemical analysis of the selected rivers in Maiduguri metropolis, Borno state. Since some of the populace depend on the rivers for domestic purposes, there is the need to assess the quality of the water and extent of contamination of these rivers for the suitability of the water for domestic purpose.

METHODOLOGY

Study Area

Maiduguri, the capital of Borno State lies within latitude 10˚N and longitude 11˚30´E and 14˚ 45́E. Borno State has an area of 61,43559km and is one of the largest states in the Federation in terms of land mass. It is located in the North Eastern corner of Nigeria and occupies the greatest part of the Chad basin, sharing borders with the Republic of Niger to the North, Chad to the North- East and Cameroun to the East (NPN 2006). Provisional census figures put Borno state to have a population of 4,151,193 and population density of approximately 60 inhabitants per square kilometer. Maiduguri is populated by civil servants, business men and women, though there are farmers, herdsman and fishermen living near and far.

Sample Collection/ Sample Preservation

Water samples of 60 liters were collected from River Ngadda and waste pond in Ramat Polytechnic Maiduguri. The surface water samples were collected at one week intervals in August, 2017 using composite sampling method. Each sample of water was collected in a clean bucket clean with cover that has been pre-washed with HNO3 and thoroughly rinsed with distilled water (Parson *et al*., 2001 and Johnstone 1995). The water was treated using the model water treatment plant (Plate 1).

Plate 1: Model water treatment plant

Sample Analysis

The temperature, pH, electrical conductivity, turbidity and dissolved oxygen of the surface water samples were determined in situ with a portable thermometer, pH meter (H1991301) and conductivity meter (H1991301), turbidity meter, DO meter respectively. While others such as total dissolve solids (TDS), Salinity, total solids, alkalinity, BOD, total hardness, sulphate, chloride, nitrate, calcium, magnesium, potassium and sodium were analyzed using APHA, 2012 in geology laboratory University of Maiduguri. The analyzed water were compared with WHO standard for it suitability.

RESULT AND DISSCUSION

Table 1 showed most of the physical parameters are within the desirable limits specified in the WHO standards, for both the river and the pond using the model treatment plant. However, the values for K, Mg, Mn, NO3, Iron, PO4, and hardness are above the WHO standards. The concentration of the chemical parameters in the pond were higher than that of the river indicating impurities from the waste disposal is of high concentration. The high concentration of K and Mg may not present a health hazard, but they do gives a salty taste to the water.

The high concentration of Fe and Mn causes discoloration of the water to reddish brown and black, which stains the laundry and sanitary wares. Nitrate and phosphate were present in concentration that could be traced back to the use of fertilizers and manure flowing into the river and pond due to activities around, which cause wide spread pollution, increase algae growth, and intensify odor (Offodile 2002). High concentration of nitrate also gives rise to potential health risks particularly for pregnant women, leading to bleeding and loss of pregnancy at early stages (Dammo and Sangodoyin, 2014).

Table 1: Physical, Chemical and biological properties of surface and pond water

Parameters	Pre- treatment		Post Treatment		MIN	MAX
	River Ngadda	Waste Pond	River Ngadda	Waste Pond		
pH	7.5	8.2	8.4	7.0	6.5	8.5
EC(us/cm)	1400	1500	300	500	1000	1450
TDS	300	450	250	350	<500	1500
DO	5	7	3	4	5	<5
BOD	6	9	4	7	10	<10
K	7	9	11	13	<10	15
Ca	65	86	55	70	75	200
Mg	38	46	40	52	<39	150
Na	130	150	100	120	<150	200
Cl	170	230	150	190	<200	500
PO4 (mg-PO4/l)	1.4	2	2.5	3	2	20
NO3 (mg-NO3/l)	25	32	22	25	<20	200
SO4	140	160	120	130	<150	250
CO3	70	100	50	75	100	250
HCO3	250	600	300	450	<500	1000
Hardness	105	120	105	120	<100	500
Mn	2	3	0.06	0.09	<0.05	0.5
Iron	1	2	0.3	0.4	<0.3	1.0
E.coli n/100 mg	25	48	0.1	0.2	<0.3	1.0

All parameters in mg/l except where noted

The presence of hardness implies that the river water contain appreciable amount of calcium and magnesium and this could come from geological formation of the area. Even though its presence in

water is beneficial to health up to a certain level, high concentration affect the taste and soap consumption in cleaning. E. coli were present in both river and pond waters at concentrations ranging from 25 to 48 n/100 mg. However, the results of post- treatment presented in table 1 showed that the constructed treatment plant model could be suitable for analyzing waste water for domestic purpose.

CONCLUSION AND RECOMMENDATION

The results from the laboratory analysis showed that most of the physical and chemical and parameters conform with WHO standards except coliform count which did not conform to the WHO standard. The t-test result reveals that there was no significant difference between the river and pond water value with the WHO standard. The model water treatment plant could be suitable for treating water for domestic usage.

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