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RESEARCH ARTICLE

Quality Analysis of Borehole Water from Selected Hostels around Kumasi Polytechnic Campus, Ghana

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Abstract

This research was carried out to ascertain the quality of borehole water from hostels which accommodates students from the Kumasi Polytechnic in terms of physical, chemical and microbiological quality parameters. Borehole water samples were analyzed for temperature, odour, appearance, taste, colour, turbidity, total suspended solids, total dissolved solids, pH, conductivity, heavy, trace metals, total and faecal coliforms. The physico-chemical results have revealed that the parameters analyzed were within the standards prescribed by World Health Organization and Ghana Standards Authority, while the concentrations of lead and manganese in different samples showed higher values. The microbiological results complied with the standards for coliforms in drinking water which means the water is safe and does not pose any health hazards to consumers.

Introduction

Healthy life depends not only on good personal hygiene but also on safe drinking water. The provision of potable water for rural and urban communities would go a long way to arrest health hazards. Ground water is the ultimate and most suitable fresh water resource for human consumption in both urban as well as rural areas (Reza & Singh, 2009).

Unfortunately, in many developing countries, availability of water has become a critical and urgent problem and is a matter of great concern to families and communities depending on non-public water supply system (Omezuruike et al, 2008). Water intended for human consumption must be free from chemical substances and micro-organisms which may provide a health hazard (WHO, 2004). About 80% diseases in the world, according to World Health Organization, are caused by inadequate sanitation, pollution and unavailability of safe drinking water. Water contaminated by microbiological pollutants spread diseases such as dysentery, cholera and typhoid (Iqbal et al., 2013). It is no doubt that a number of impurities in the form of dissolved particles of soil, garbage, sewage, pesticides and other human, animal or industrial/chemical pollutants find their ways into water supplies. The incidence of ground water pollution is highest in urban areas where large volumes of wastes are concentrated and discharged into relatively small areas (Reza & Singh, 2009). Some of these impurities may render the water harmful and unfit for human consumption.

Hostels within the Kumasi Polytechnic vicinity provide borehole water (without a detailed chemical analysis) as the main source of water for drinking, laundry and domestic purposes for students. The incessant increase in the number of students which may result in undue pressure on the bore water and likely pollution from industries and agricultural activities makes quality studies a necessity (Rieberger, 2007). Although several studies have been conducted to address water quality in some parts of Kumasi, no previous studies have been conducted to date addressing borehole water quality of hostels around the Polytechnic campus. A detailed knowledge of water quality in these hostels is essential so that drinking water can be adequately treated and the contamination of its sources can be prevented. This work, therefore, aims at examining the physical, chemical and microbiological characteristics on bore water in selected hostels around the campus and to determine whether or not the water is potable. The results can help planners and decision makers in selecting good water management policies for hostel managers in the study area.

Material and Methods

Materials

Chemicals

Distilled water, nitric acid, sulfuric acid, hydrochloric acid, silver nitrate, potassium chromate

Equipment

A HACH ICP Spectrometer (Thermo Scientific ICAP 6000) was used for the determination of toxic heavy metals and trace metals. The HACH Spectrophotometer (DR 5000) was also used for determining colour, total suspended solids and some inorganic metals. We used a HACH pH/Cond & TDS meter (HQ40d) on field in determining pH, conductivity and total dissolved solids. A Eutech Turbidity meter (Cyaberscan IR Turbidymeter, TB 1000) was used in analyzing turbidity. Wagtech Incubator (Potalab) and Wagtech Colony Counter, (SC6) were all used for the microbiological analyses.

Methods

Collection and Storage of Samples

Borehole water samples were collected in June, 2014 from selected hostels in the Kumasi Polytechnic community (Fig. 1). The hostels were selected randomly so that it represented not only the most patronized ones but also the aquatic systems from which the samples are drawn. A volume of 2 L for each sample was collected by allowing the tap to run for at least 5 min (APHA, 2005) before collecting them into prewashed (with detergent, dilute hydrochloric acid, tap water and doubly distilled water) sterilized polyethylene bottles, double capped and labelled accordingly. The samples were transported to the laboratory with a little delay as possible. As a means of minimizing physico-chemical changes, these samples were stored at 4 °C for 48 hours (APHA, 2005).

Physical Analysis of Samples

In all cases, the instruments were duly calibrated before carrying out the respective analysis. Temperature and appearance of water samples were determined. Turbidity was determined as soon as the samples were taken using a EUTECH turbidity meter (TB 1000). The pH, conductivity and total dissolved solids (TDS) were determined on field using a HACH multi parameter (HQ40d). The apparent and true colour were determined according to APHA Platinum-Cobalt standard method (APHA, 2005). Total suspended solids (TSS) was measured using a HACH DR 5000 UV-VIS Spectrophotometer with reference to American Public Health Association guidelines (APHA, 2005). Replicate analyses were carried out for each determination to ascertain reproducibility and quality assurance.

Chemical Analysis of Samples

All chemicals used in this study were of analytical grade (BDH), and all the experimental solutions used prepared with doubly deionized water. The samples were analyzed according to standard methods and protocols described in Standard Methods for the Examination of Water and Waste Water guidelines (APHA, 2005). The toxic heavy metals and trace metals (inorganic solutes) were determined using a HACH Spectrophotometer (DR 5000). Other metals were determined by inductively coupled plasma atomic emission spectroscopy with HACH ICP Spectrometer (Thermo Scientific ICAP 6000). The results were compared with the World Health Organization and Ghana Water Standards GS 175-1: 2009 for drinking water quality parameters.

Microbiological Quality Analysis of samples

Microbiological analysis was done immediately after sampling to avoid changes in the microbial population. Using total and faecal coliforms as indicators, the bacteriological quality of the water samples were assessed using standard membrane filtration technique (APHA, 2005). Multiple tube technique was used for the counting of most probable number of coliform bacteria (Antony & Renuga, 2012).

Result and Discussion

Water samples collected from hostels around Kumasi Polytechnic campus (Fig. 1) were extensively tested in the laboratory to analyse parameters such as temperature, odour, appearance, taste, colour, turbidity, total suspended solids, total dissolved solids, pH, conductivity, toxic heavy metals, trace metals (inorganic solutes), total and faecal coliforms. Details of sampling locations and general status of collected samples are presented in Table 1.

Table 1 Sampling locations and general status of samples

S/N.	Name of Hostel	Hostel Code	Temp. (°C)	Appearance
1	Obaapa	QA/OB/14	33	Clear
2	Cyborg 3	QA/CY/14	32	Clear
3	Crystal Rose	QA/CR/14	33	Clear
4	Fosuah Memorial	QA/FM/14	34	Clear
5	K'Poly GETFUND	QA/KP/14	32	Clear

Analyses carried out shows that temperature range from 32 to 34 °C (Table 1) with the highest value recorded for Fosuah Memorial Hostel. Colour and odour are the direct indication of contaminations (Iqbal et al., 2013). Appearance of samples were clear in general, while odour was unobjectionable, an indication of the absence of organic substances.

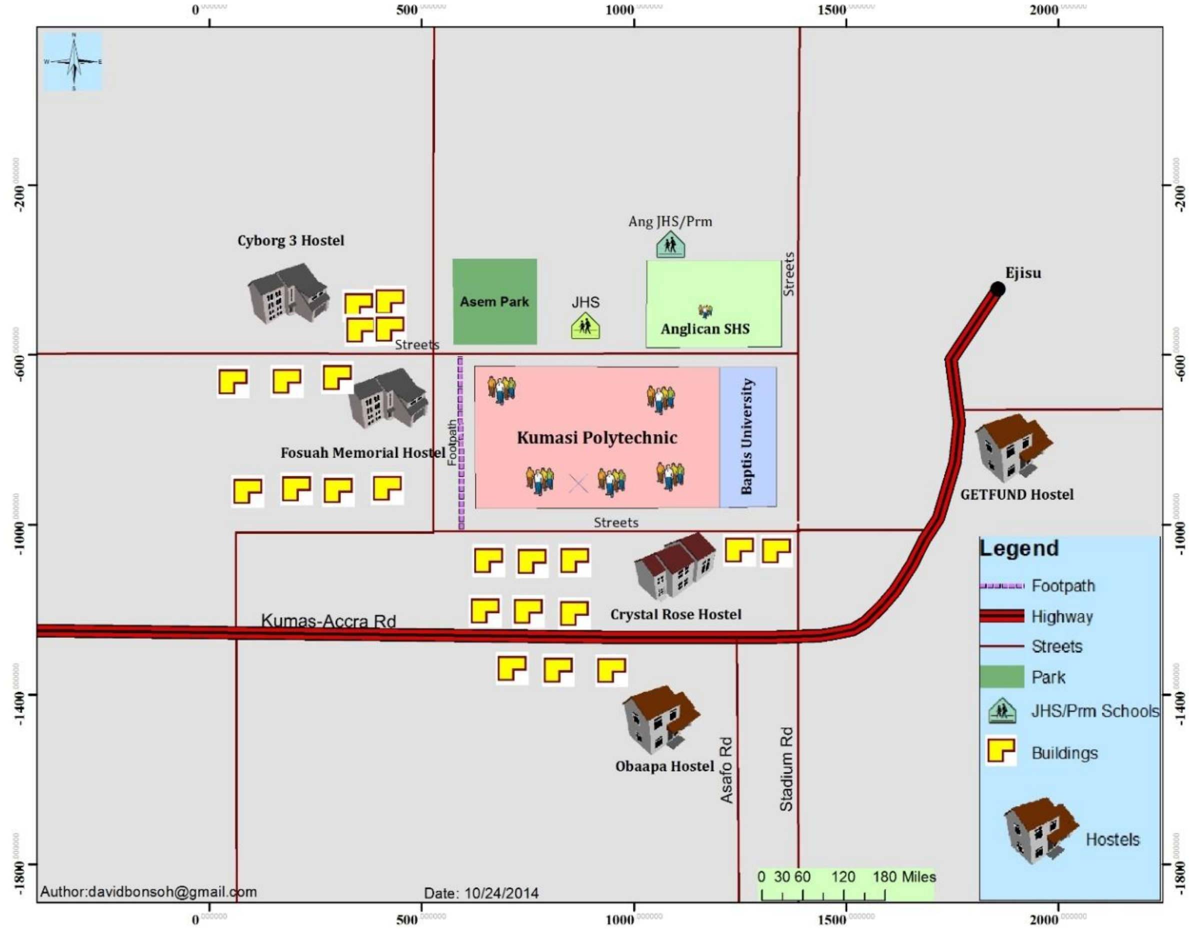

Fig. 1 Location map showing the sampling sites

Physical parameters in the bore water samples are shown in Table 2. pH varied between 6.51 and 8.55 which mean that the water samples are slightly alkaline in nature. This could be considered as being within acceptable range for drinking water (Ghana Standards Authority, 2009) (WHO, 2004) except a deviation recorded for K'Poly GETFUND hostel (pH = 8.55). Electrical conductivity, signifying the amount of total dissolved salts, varied between 187 and 384 µS/cm with a mean of 239.16±0.06 µS/cm. This confirms the fact that the water samples have low concentration of organic substances but the presence of high concentration of dissolved inorganic substances in ionized form (Pandey & Pandey, 2012). Turbidity of water is important in producing products destined for human consumption and in many manufacturing uses (APHA, 2005). Turbidity, which is a measure of the cloudiness of water ranged from 0.57 to 0.96 which and found within the permissible limit of 1 (Ghana Standards Authority, 2009) (WHO, 2004). Colour of analyzed samples ranged from <1 to 9 Pt/Co. The values for colour are within permissible limits (15 Pt/Co) and similar to that reported by David et al., 2013. Total suspended solids in water samples varied from <1 to 3 mg/L. The total dissolved solids values were also far below the permissible limits of 1000 mg/L varying between 57.1 to 184.7 mg/L (Table 2).

Table 2 Mean physical parameters in bore water samples

Sample ID	pH	Conductivity (µS/cm)	Turbidity (NTU)	Colour (Pt/Co)	TSS* (mg/L)	TDS** (mg/L)
QA/OB	6.63 ± 0.20	222.00 ± 0.03	0.78 ± 0.13	2.00 ± 0.01	<1.00 ± 0.00	105.90 ± 0.18
QA/CY	6.51 ± 0.25	282.00 ± 0.05	0.57 ± 0.09	<1.00 ± 0.00	<1.00 ± 0.00	134.80 ± 0.11
QA/CR	7.57 ± 0.33	384.00 ± 0.10	0.90 ± 0.16	9.00 ± 0.04	3.00 ± 0.08	184.70 ± 0.20
QA/FM	7.95 ± 0.28	187.00 ± 0.05	0.96 ± 0.20	<1.00 ± 0.00	<1.00 ± 0.00	89.10 ± 0.13
QA/KP	8.55 ± 0.19	120.80 ± 0.05	0.85 ± 0.17	<1.00 ± 0.00	<1.00 ± 0.00	57.10 ± 0.16
Mean	7.44 ± 0.25	239.16 ± 0.06	0.812 ± 0.15	4.00 ± 0.01	3.00 ± 0.02	114.32 ± 0.16
Range	6.51 – 8.55	187.00 – 384.00	0.57 – 0.96	<1.00 – 9.00	<1.00 – 3.00	57.10 – 184.70
GS 175-1: 2009	**6.5 – 8.5**	**1500**	**1**	**15**	**N/A**	**1000**

*TSS: Total suspended solids, **TDS: Total dissolved solids

Table 3 Mean essential and mineral elements in bore water samples

Sample ID	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	$N\text{-}NO_2$ (mg/L)	$N\text{-}NO_3$ (mg/L)	$N\text{-}NH_3$ (mg/L)	P (mg/L)
QA/OB	3.36 ± 0.15	3.31 ± 0.03	22.87 ± 1.12	3.05 ± 2.12	0.03 ± 0.85	9.10 ± 2.86	0.95 ± 0.02	<0.0002 ± 0.01
QA/CY	6.47 ± 0.19	6.29 ± 0.07	21.36 ± 0.98	6.71 ± 1.98	0.03 ± 1.21	10.20 ± 1.87	0.30 ± 0.56	<0.0002 ± 0.00
QA/CR	11.42 ± 0.08	9.99 ± 0.10	34.67 ± 1.78	6.24 ± 1.58	0.02 ± 0.96	10.60 ± 0.84	0.05 ± 0.98	0.01 ± 1.98
QA/FM	5.32 ± 0.14	2.89 ± 0.01	21.32 ± 0.86	2.69 ± 2.01	0.03 ± 0.02	7.50 ± 1.23	0.22 ± 0.65	<0.0002 ± 0.00
QA/KP	4.36 ± 0.11	1.38 ± 0.08	12.33 ± 1.03	4.09 ± 0.87	0.03 ± 0.34	7.50 ± 1.84	0.02 ± 1.98	0.41 ± 0.96
Mean	6.18 ± 0.13	4.78 ± 0.06	22.51 ± 1.15	4.55 ± 1.71	0.03 ± 0.68	8.98 ± 1.73	0.31 ± 0.84	0.21 ± 0.60
Range	3.36 – 11.42	1.38 – 9.99	12.33– 34.67	2.69 – 6.71	0.02 – 0.03	7.50 – 10.60	0.02 – 0.95	<0.0002 – 0.41
GS 175-1: 2009	**40**	**N/A**	**200**	**30**	**3**	**50**	**2.5**	**0.01**

N/A: Not applicable

Table 4a Mean essential and toxic elements in bore water samples

Sample ID	Ag-D (mg/L)	Al-D (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Bi (mg/L)	Li (mg/L)	Sr (mg/L)	Th (mg/L)	Tl (mg/L)	U (mg/L)	V (mg/L)
QA/OB	0.1216 ± 0.32	0.6998 ± 1.22	<0.0002 ± 0.00	0.2117 ± 1.89	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0358 ± 0.39	0.0162 ± 0.08	<0.0001 ± 0.00	<0.0002 ± 0.00	<0.0002 ± 0.00	0.0014 ± 0.02
QA/CY	0.1138 ± 0.22	0.5760 ± 0.96	<0.0002 ± 0.00	0.4567 ± 0.96	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0360 ± 1.22	0.0284 ± 1.24	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0596 ± 0.38	0.0018 ± 0.08
QA/CR	0.1160 ± 0.09	0.0580 ± 1.56	<0.0002 ± 0.00	0.5417 ± 2.20	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0608 ± 0.38	0.1037 ± 0.01	<0.0001 ± 0.00	<0.0002 ± 0.00	0.1729 ± 0.78	0.0032 ± 0.23
QA/FM	0.1291 ±0.18	0.2469 ± 0.98	<0.0002 ± 0.00	0.2053 ± 1.67	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0376 ± 0.08	0.0172 ± 0.94	<0.0001 ± 0.00	<0.0002 ± 0.00	0.1746 ± 0.98	0.0014 ± 0.88

QA/KP	0.1208 ± 0.67	0.2067 ± 0.68	<0.0002 ± 0.00	0.0454 ± 0.78	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0453 ± 1.38	0.0092 ± 0.03	<0.0001 ± 0.00	<0.0002 ± 0.00	0.1528 ± 1.29	0.0012 ± 1.21
Mean	0.1208 ± 0.30	0.3574 ± 1.08	<0.0002 ± 0.00	0.2922 ± 1.50	<0.0001 ± 0.00	<0.0002 ± 0.00	0.0431 ± 0.70	0.0349 ± 0.46	<0.0001 ± 0.00	<0.0002 ± 0.00	0.1399 ± 0.69	0.0018 ± 0.48
Range	0.1138 – 0.1291	0.0580 – 0.6998	<0.0002	0.0454 – 0.5417	<0.0001	<0.0002	0.0358 – 0.0453	0.0092 – 0.1037	<0.0001	<0.0002	<0.0002 – 0.1746	0.0012 – 0.0032
GS 175-1: 2009	**0.1**	**0.2**	**0.5**	**0.7**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

N/A: Not applicable

Table 4b Mean concentration of heavy metals in bore water samples

Sample ID	**As (mg/L)**	**Cd (mg/L)**	**Co (mg/L)**	**Cr (mg/L)**	**Cu (mg/L)**	**Fe (mg/L)**	**Hg (mg/L)**	**Mn (mg/L)**	**Ni (mg/L)**	**Pb (mg/L)**	**Se (mg/L)**	**Zn (mg/L)**
QA/OB	0.0008 ± 0.24	0.0011 ± 0.79	0.0057 ± 0.98	0.0033 ± 0.06	0.2180 ± 0.55	0.0459 ± 0.97	<0.0001 ± 0.00	0.2823 ± 0.65	0.0229 ± 0.87	0.0186 ± 0.86	0.0037 ± 0.02	0.1003 ± 0.14
QA/CY	<0.0001 ± 0.00	0.0008 ± 0.08	0.0238 ± 1.10	0.0041 ± 0.09	0.1634 ± 0.91	0.1009 ± 0.07	<0.0001 ± 0.00	0.6357 ± 0.07	0.0613 ± 0.08	0.0070 ± 0.58	0.0073 ± 0.04	0.0646 ± 0.87
QA/CR	0.0016 ± 0.08	0.0003 ± 0.97	0.0034 ± 0.06	0.0059 ± 0.14	0.0833 ± 1.34	0.0660 ± 0.02	<0.0001 ± 0.00	0.0994 ± 0.01	0.0254 ± 0.54	0.0027 ± 0.98	0.0085 ± 0.09	0.0338 ± 1.88
QA/FM	0.0009 ± 0.77	0.0014 ± 0.01	0.0064 ± 0.72	0.0035 ± 0.85	0.1408 ± 0.86	0.2287 ± 0.04	<0.0001 ± 0.00	0.1812 ± 0.96	0.0235 ± 0.76	0.0034 ± 0.71	<0.0001 ± 0.00	0.0491 ± 1.24
QA/KP	<0.0001 ± 0.00	0.0003 ± 0.43	0.0008 ± 1.34	0.0017 ± 0.97	0.2464 ± 0.66	0.2536 ± 0.72	<0.0001 ± 0.00	0.0881 ± 0.08	0.0083 ± 0. 06	0.0009 ± 0.02	0.0073 ± 0.03	0.0382 ± 0.85
Mean	0.0011 ± 0.22	0.0008 ± 0.46	0.0081 ± 0.84	0.0037 ± 0.42	0.1704 ± 0.86	0.1390 ± 0.36	<0.0001 ± 0.00	0.2573 ± 0.35	0.0283 ± 0.46	0.0065 ± 0.63	0.0067 ± 0.04	0.0572 ± 1.00
Range	<0.0001 – 0.0016	0.0003 – 0.0014	0.0008 – 0.0238	0.0017 – 0.0059	0.0833 – 0.2180	0.0459 – 0.2536	<0.0001	0.0881 – 0.6357	0.0083 – 0.0613	0.0009 – 0.0186	<0.0001 – 0.0085	0.0338 – 0.1003
GS 175-1: 2009	**0.01**	**0.003**	**N/A**	**0.05**	**1**	**1**	**0.001**	**0.4**	**0.07**	**0.01**	**0.01**	**3**

N/A: Not applicable

Mean concentrations of essential and mineral elements are presented in Table 3. Calcium and magnesium are important minerals in the earth crust and natural waters that form highly soluble salts (Iqbal et al., 2013). Calcium which is related to water hardness ranged from 3.36 to 11.42 mg/L. Magnesium ion concentration in bore water samples varied between 1.38 and 9.99 mg/L. Calcium and magnesium in all the samples are below the permissible limits (Ca: 40 mg/L, Mg: N/A) as prescribed by Ghana Water and Word Health Organization. Sodium and potassium concentrations ranged from 12.33 to 34.76 mg/L and 2.68 to 6.70 mg/L respectively. These values are far below the WHO safe guidelines for drinking water. Nitrite-nitrogen and nitrate-nitrogen contained in the bore water samples ranged from 0.02 to 0.03 mg/L and 7.50 to 10.60 mg/L respectively. All values are within the permissible limits (3 and 50 mg/L respectively) of GS 175-1:2009. Ammonia may be present in drinking water because of disinfection with chloramines (WHO, 2004). The values for ammonia concentration recorded for bore water varied from 0.02 to 0.95 mg/L. The values were below the World Health Organization (WHO, 2004) and Ghana Water Standards GS 175-1:2009 permissible limits of 1.5 mg/L. Phosphate levels were very minimal and ranged from 0.00 to 0.41 mg/L. The concentrations of metal elements like Ag, Al, As, B, Ba, Be, Bi, Cd and Co analyzed in the bore water samples are shown in Table 4a. Ag-D was in the range 0.1138 to 0.1291 mg/L, Al-D: 0.058 to 0.6998 mg/L, As: <0.0001 to 0.0016 mg/L, B: <0.0002 mg/L for all samples, Ba: 0.0454 to 0.5417 mg/L, Be: <0.0001 mg/L for all samples, Bi: <0.0002 mg/L for all samples, Cd: 0.0003 to 0.0014 mg/L and Co: 0.0008 to 0.0238 mg/L. It can be inferred that the metal concentration in all the collected samples were below the permissible limit (Ghana Standards Authority, 2009). This water is thus optimal in metal concentration and hence of good quality with respect to these metals. Other metal concentrations analyzed in the collected samples are shown in Table 4a. Magnesium and manganese were in the range 1.38 to 9.987 mg/L and 0.081 to 0.6357 mg/L respectively. These values were within the prescribed limits (Ghana Standards Authority, 2009). Strontium ranged from 0.0092 to 0.1037 mg/L, Th: <0.0001 mg/L for all samples, Tl: <0.0002 mg/L for all samples, U: <0.0002 to 0.1746 mg/L, Li: 0.0358 to 0.0453 mg/L and V: 0.0012 to 0.0032 mg/L. These levels are all very low meaning the water is not polluted as far as the concentrations of these metals are concerned. (Ghana Standards Authority, 2009) (WHO, 2004).

Heavy metal concentrations in borehole water samples are shown as part of Table 4b. These metals have no known physiological activity on plants and microorganisms but can cause serious health effects with varied symptoms depending on the nature and quantity of the metal ingested (Mamodu & Anyakora, 2010). Therefore, monitoring of these metals is important for safety assessment of the environment and human health in particular (Iqbal et al., 2013). Arsenic was in the range <0.0001 to 0.0016 mg/L. Arsenic concentration is thus below the permissible limit of 0.01 mg/L. (WHO, 2004). Cadmium, chromium and copper concentrations were found in the range of 0.0003 to 0.0014 mg/L, 0.0017 to 0.0059 mg/L and 0.0833 to 0.218 mg/L respectively. Levels of cadmium, chromium and copper are within the permissible limits (WHO, 2004) (Ghana Standards Authority, 2009). Iron, mercury and zinc ranged from 0.0459 to 0.2536 mg/L, <0.0001 mg/L for all samples and 0.0338 to 0.1003 mg/L respectively. These concentrations were also lower than the WHO and GSA permissible limits.

Similarly, lead concentration was found in the range of 0.0009 to 0.0186 mg/L, Mn: 0.0881 to 0.6357 mg/L, Co: 0.0008 to 0.0238 mg/L, Ni: 0.0083 to 0.0613 mg/L and Se: <0.0001 to 0.0085 mg/L. Higher concentration of lead ie. 0.0186 ± 0.86 mg/L (above the permissible limit) was recorded Obaapa Hostel (Table 4b). This could be attributed to the passage of water through lead pipes or tanks (Peiravi et al., 2013). The higher lead concentration of lead is of concern because lead is a poisonous metal that can damage nervous connections (especially in young children) and cause blood and brain disorders (Mohod & Dhote, 2013). Studies have linked lead exposures even at low levels with an increase in blood pressure (Mamodu & Anyakora, 2010). The presence of elevated levels of lead interferes with haemo synthesis, which leads to haematological damage (Mohod & Dhote, 2013). Necessary measures like changing decayed pipes, using lead-free pipes and water blending must be employed. Cyborg 3 Hostel recorded manganese concentration of 0.6357 ± 0.07 mg/L (Table 4b), a value above the permissible level as per WHO and GSA of 0.4 mg/L, and could probably be attributed to leaching of industrial effluent and sewage (Ministry of Environment, 2007). Manganese is naturally occurring in many surface and ground water sources and in soils that may erode into these waters (USEPA, 2004). However, health effects from manganese are not a concern until concentrations are approximately 10 times higher than 0.05 milligrams per liter of water (Department of Public Health, 2007). An epidemiological study in Japan described adverse effects in humans consuming higher concentration of manganese dissolved in drinking-water with the most severe effects seen in elderly people and less severe effects seen in younger people (WHO, 2011). Exposure to high concentrations of manganese over the course of years has been associated with toxicity to the nervous system, producing a syndrome that resembles Parkinsonism, a progressive nervous disorder marked by symptoms of trembling hands, lifeless face, monotone voice, and a slow shuffling walk. This type of effect may be more likely to occur in the elderly (Department of Public Health, 2007). It is obvious from the results that cobalt, nickel and selenium in all the samples were found below the permissible limits (fig. 8) as prescribed by WHO and GSA.

Total coliform count and faecal coliform count (microbial analysis) were analysed for 24 and 48 hours duration. The average microbiological quality of different bore water samples are presented in Table 5.

Table 5 Microbiological Quality of bore water samples

Sample/Hostel Code	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100ml)
QA/OB/14	0	0
QA/CY/14	0	0
QA/CR/14	0	0
QA/FM/14	0	0
QA/KP/14	0	0
GS 175-1: 2009	**0**	**0**

The bacteriological analysis of water determines the potability of water (Antony & Renuga, 2012). Drinking water regulations require that water intended for human consumption must be free from microorganisms including all disease-causing bacteria in amounts which would provide a hazard to health (WHO, 2004). The results show that all the bore water samples contained zero (0) total and faecal coliform per 100 ml of water (Table 2) and thus complies with the standards for coliforms in drinking water (Ghana Standards Authority, 2009) (WHO, 2004). This means the water is safe and does not pose any health hazards to consumers.

Conclusions

Hostels within the vicinity of Kumasi Polytechnic continue to provide accommodation for students. Amidst growth and development in recent years, risks to water quality like leaching of industrial effluent, and sewage disposal have been the order of the day. Despite the increased development, the overall water quality of samples from the students' hostels from both chemical and physical perspectives remains remarkably good. All physico-chemical parameters have met water quality standards. The analyses revealed that water chemistry parameters including metal concentrations are within the permissible levels and do not suggest any problem at this time. The microbiological results complied with the standards for coliforms in drinking water which means the water is safe and does not pose any health hazards to consumers. The findings suggest the need to control lead and manganese concentrations.

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