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Preliminary Study of the Impact of Poor Waste Management on the Physicochemical Properties of Ground Water in some Areas of Ibadan

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ABSTRACT
This study was carried out to investigate the impact of poor waste management on the physicochemical properties of ground water in Ibadan which will be reflected in the extent of contamination of wells in order to establish its suitability for drinking. Twenty samples of ground water (well), collected from five local governments in Ibadan were analysed for colour, temperature, pH, total solids, total dissolved solids, total suspended solids, total hardness, magnesium hardness, calcium hardness, chloride, alkalinity and dissolved oxygen using standard methods. The ranges for temperature, pH, total solids, total dissolved solids and total suspended solids were 23-30°C, 4.57-6.55, 124.5-1585, 40.5-1490 and 30-270 mg L^{-1}, respectively. While that of total hardness, magnesium, calcium, chloride, alkalinity and dissolved oxygen were 22-202, 2-60, 20-186, 20-510, 30-430 and 2.34-7.11 mg L^{-1}. Fifteen of the water samples were colourless and the others were turbid. The results obtained for pH (95%), Magnesium (25%), Chloride (20%), Alkalinity (55%), all exceeded the W.H.O maximum permissible limits, indicating that some of the groundwater samples in Ibadan city were contaminated to various extents probably from lack of proper waste management.

Key words: Water samples, waste, colour, contaminated, ibadan

INTRODUCTION
Ibadan city in Nigeria is one of the largest in the Sub-Saharan Africa, with an estimated population of more than 4 million and an area of about 180 sq. km. The National Water Corporation is responsible for planning, treating and supplying public water. The supply has been inadequate and forced inhabitants of the city to resort to drinking water from wells (Dawodu and Ipaiyeda, 2007). Fresh water resources are one of the most important resources for life on earth. As a result suitable water supply in terms of quality and quantity is of vital importance (Baghvand *et al.*, 2006).

Water of sufficient quality to serve as drinking water is termed potable water whether it is used as such or not. Although many sources are utilized by humans, some contain disease vectors or pathogens and cause long-term health problems if they do not meet certain water quality guidelines. These resources are under threat of pollution from human life style manifested by the low level of hygiene practiced in the developing nations (Adekunle *et al*., 2007). Contaminants can find their way into ground water through activities like industrial discharges, seepage of municipal landfills, septic tank effluents etc. Indiscriminate dumping of waste can be serious in cities lacking efficient waste disposal system or treatment plants and this we find in most Nigerian cities (Okuo *et al*., 2007).

Increased man activities for socio-economic development have resulted in huge deposits of domestic, industrial and environmental waste which constitute environmental hazards. Waste disposal management in Nigeria is a problem. Domestic wastes, municipal solid waste, urban waste are usually collected at central units before they are transported to incineration units or landfill areas. This is usually not effective as delays are encountered and most times people have resulted to use of drainage systems as a means of waste disposal. Infact, Nigeria generates about 2.4 million tons of municipal solid waste yearly (Ikuponisi, 2004).

As a result of the over stressed sewage system, most of the canals are often little better than open sewers. In addition, the improper disposal of solid and liquid waste near residential areas, poor waste collecting and handling, access roads and the state of physical infrastructure contribute to the sewage problems. In all these cases, it is expected that the direct input of organic species of biological origin, major and minor inorganic species and bacteria will occur in the aquifer. A considerable amount of domestic and industrial waste generated are dumped within the city. Such waste will provide pollutants ranging from the Cl- through N-species and metals to organic species associated with putrescible materials (Yusuf, 2007). Some wastes are disposed through the sewer system or via the surface water courses. Many of the small premises do not have access to any disposal system other than allowing waste to soak into the ground. Industrial contaminants can also gain access to the local aquifer either via interaction with the surface water bodies or directly through infiltration (Yusuf, 2007).

Biogas generation and biogas gasification are two ways in which waste can be properly managed. Biogas generation is a clean waste disposal technique that involves the anaerobic digestion of degradable biomass materials which includes: industrial effluents, animal and plant waste. Biomass gasification technology (also a clean waste disposal technique) is a thermo-physical process that utilizes biological materials (biomass) in the production of producer gas for cooking, heating, smelting and electricity generation which is (Okorigwe *et al*., 2008).

In an industrial area as is the case with Ibadan, possibility exists for percolation and migration of pollutants via soil into drinking wells. Thus drinking wells may be impaired physiochemically (Lam *et al*., 1994). While drinking water standards are in force for public water systems, private water supplies are not subjected to these standards (Amoo and Akinbode, 2007). It is virtually important that the water which humans drink should be free of disease causing germs and toxic chemicals that pose a threat to public health (TWAS, 2002).

The aim of the study was to find out the impact of poor waste management on the physicochemical properties of ground water in Ibadan which will be reflected in the extent of contamination of wells in order to establish its suitability for drinking.

MATERIALS AND METHODS

This study was carried out from January to March, 2004 at the University of Ibadan. Water samples were collected from twenty different wells singly into already properly washed two litres plastic containers. The containers were labeled and stored in the laboratory refrigerator prior to analysis. The water samples for dissolved oxygen were collected in properly washed glass bottles of 120 mL capacity with glass stoppers labeled and stored in the laboratory refrigerator prior to analysis.

Determination of relevant parameters: Colour and odour were analysed with the sensory organs. The temperature of the water samples were determined by dipping a Mercury in glass thermometer (British standard BS593). pH was determined using a Hanna pH meter model no 02895 (Ademoroti, 1996), Total solids, total dissolved solids and total suspended solids were determined by gravimetry (Ademoroti, 1996). Total hardness, magnesium and calcium were determined by EDTA titrimetry (APHA, 1992). Alkalinity was determined by titration with HCl (APHA, 1992). Chloride was determined by Mohr's method and dissolved oxygen by Winkler's method (APHA, 1992).

RESULTS AND DISCUSSION

Table 1, shows the results of the physicochemical properties. All the ground water samples were colourless except for ground water samples 2, 6, 14 and 16 and 20. All the water samples were odourless. Temperature range for all the samples were between 23-30°C. pH values obtained for the water samples were between 4.57-6.55. The chloride content for the water samples were in the

Table 1: Mean values of the physicochemical properties of the ground water (Well) samples in ibadan

			Parameter									
Sample	Colour	Temperature ture (°C)	pH	Chloride	Total hardness	Mg	Ca	TS	TDS	TSS	Alkalinity	Dissolved oxygen
				(mg L^{-1})								
GW 1	Colourless	28.00	5.70	30.00	34.00	4.00	30.00	249.00	199.50	50.00	70.00	7.01
GW 2	Turbid	29.00	5.40	50.00	22.00	2.00	20.00	355.00	90.00	265.00	50.00	5.08
GW 3	Colourless	29.00	5.11	90.00	44.00	2.00	42.00	1200.50	1110.00	90.00	30.00	3.86
GW 4	Colourless	27.00	6.19	50.00	104.00	10.00	94.00	240.00	40.50	200.00	130.00	5.38
GW 5	Colourless	29.50	5.92	140.00	78.00	4.00	74.00	235.00	185.00	30.00	100.00	3.86
GW 6	Turbid	29.00	6.01	160.00	164.00	4.00	160.00	610.00	485.00	125.00	120.00	5.59
GW 7	Colourless	30.00	5.50	30.00	26.00	16.00	10.00	124.50	54.50	70.00	60.00	5.69
GW 8	Colourless	26.00	5.84	50.00	88.00	12.00	76.00	365.00	95.00	270.00	120.00	3.25
GW 9	Colourless	29.50	5.70	20.00	38.00	14.00	24.00	190.00	90.00	100.00	80.00	4.06
GW 10	Colourless	30.00	6.24	60.00	82.00	8.00	74.00	345.00	275.00	70.00	140.00	3.56
GW 11	Colourless	29.00	5.58	90.00	38.00	10.00	28.00	425.00	190.00	235.00	50.00	5.08
GW 12	Colourless	23.00	5.95	40.00	82.00	30.00	52.00	300.00	250.00	50.00	120.00	4.37
GW 13	Colourless	27.00	5.80	140.00	110.00	24.00	86.00	505.00	455.00	50.00	70.00	7.11
GW 14	Turbid	28.00	5.97	340.00	27.00	5.20	22.00	1185.00	1080.00	105.00	200.00	5.49
GW 15	Colourless	29.00	5.90	80.00	72.00	2.00	70.00	468.00	368.00	100.00	110.00	5.79
GW 16	Turbid	30.00	6.33	510.00	180.00	16.00	164.00	575.00	515.00	60.00	300.00	4.57
GW 17	Colourless	29.00	5.66	290.00	112.00	2.00	110.00	780.00	635.00	145.00	110.00	3.05
GW 18	Colourless	29.00	4.57	430.00	202.00	34.00	186.00	1585.00	1490.00	95.00	50.00	4.47
GW 19	Colourless	29.00	5.84	30.00	54.00	34.00	20.00	765.00	665.00	100.00	70.00	4.06
GW 20	Turbid	29.00	6.55	50.00	162.00	60.00	102.00	500.00	400.00	100.00	430.00	2.34
Mean		29.00	5.78	134.00	86.00	17.00	71.00	550.00	444.00	117.00	121.00	4.68
Deviation		1.60	0.43	140.00	54.00	15.00	49.00	374.00	390.00	70.00	93.00	1.20

TS: Total solids, TSS: Total suspended solids, TDS: Total dissolved solids range of 20-510 mg L^{-1}. Total hardness for the water samples were between 22-202 mg L^{-1}. Calcium and magnesium content were in the range of 10-186 and 2-60 mg L^{-1}, respectively. The total solids, total dissolved solids and total suspended solids concentration were in the range of 124-1585, 40-1490 and 30-270 mg L^{-1}, respectively for all the water samples. Finally, the concentration of the dissolved oxygen for all the water samples were 2.34-7.11 mg L^{-1} while the concentration for alkalinity was 30-430 mg L^{-1}.

The temperature for all the water samples ranged between 23-30°C which is below that reported by Amoo and Akinboda (2007) in his analysis of well water in minna and environs. However some of the values were within the range of 26-28°C obtained from Laghari *et al.* (2004) in his investigation of effect of wastewater on the quality of ground water from southern parts of Hyderabad City. Most of the water samples were colourless and all were odourless which made the well water acceptable to consumers. The results of the physicochemical parameters were compared with WHO (2003) standard shown in Table 2. The pH values of all the water samples was between 4.57-6.55 with only one of the samples falling within the range stipulated by W.H.O permissible limit, others were far lower. Such low values of pH shows the water samples were acidic and are likely to be corrosive and therefore might not be suitable for drinking overtime. This was also the case with Okoli *et al.* (2005) who obtained an average value of 4.93 for analysis of ground water utilized by resident students of a Nigerian University. However appropriate values within the range stipulated by WHO (2003) have been derived from investigators of ground water quality (Assubaie, 2004; Jafari *et al.*, 2008; Shanthakumari *et al.*, 2007). The results of the total solids, total dissolved solids and total suspended solids which were 124.5-1585, 40.5-1490 and 30-270 mg L^{-1} respectively show that none had high concentration of solids as only one slightly exceeded the 1500 mg L^{-1} maximum permissible limit by WHO. Total hardness of all the water samples with a range of 22-202 mg L^{-1} were all below the 500 mg L^{-1} maximum permissible limit by WHO. Al-Salamah and Nassar (2009), also obtained a concentration of 278.26 ppm for the total hardness of their water sample. Concentration of the magnesium of all the samples were between 2-60 mg L^{-1} and five of the samples exceeded the maximum permissible limit of 20 mg L^{-1}. For the Chloride, the concentration range was 20-510 mg L^{-1}, with four of the samples exceeding the maximum permissible limit of 250 mg L^{-1} indicating the probable contamination of those water samples with waste. This is really high compared to the concentrations obtained from other studies. For instance Okoli *et al.* (2005) obtained 0.04 mg L^{-1} in their study of ground water quality. The high concentration of chloride in any water sample renders it unhealthy for use as drinking water. Eleven samples of the ground water exceeded the maximum permissible limit of 100 mg L^{-1} for alkalinity, with the concentration of all the samples ranging between 30-430 mg L^{-1}. Alkalinity indicates the level of carbonate, bicarbonate and hydroxyl groups in water samples. The ground water sample 20 with the highest pH also had the highest concentration for alkalinity.

Table 2: WHO standards for specified physicochemical properties for drinking water

Parameter	Maximum permissible limit
Odour	Unobjectionable
Taste	Unobjectionable
pH at 20°C	6.50-9.50
Total Solids	1500 (mg L^{-1})
Total hardness	500 (mg L^{-1})
Magnesium	20 (mg L^{-1})
Total Alkalinity	100 (mg L^{-1})
Chloride	250 (mg L^{-1})

Source: WHO (2003)

CONCLUSION

The result of the analyses indicates that some of the ground water samples in Ibadan were contaminated to various extents; however a few conformed to the WHO standard for drinking water. Therefore, there is the need for government agencies and health organizations to enhance ground water quality and treatment in Ibadan since majority of the population rely on ground water as a major source of drinking water. Proper treatment of effluents from industries and efficient management of solid and hazardous waste will help maintain ground water quality.

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