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INFLUENCE OF LANDFILLS ON THE PHYSICAL AND BIOLOGICAL PROPERTIES OF NEARBY WELLS

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ABSTRACT

Groundwater samples from twenty shallow wells were investigated for possible contamination. The wells were located close by landfill sites which could be the source of pollution due to the leachates produced from the latter. The results show only four samples to be clear in appearance, while others appeared cloudy. Temperature ranged between 26.2^oC and 26.9^oC for all the twenty samples and pH was satisfactory for all samples except S_3, S_{15} and S_{19} which were slightly acidic at pH 5.57, 5.19 and 6.12 respectively. However, only sample S_3 was objectionable due to its odor. Color ranged between 4.1 and 13.2 Hazen for all the samples, while only samples S_5, S_{16} and S_{19}fell within the standard of 5 Hazen. Total dissolved solids (TDS) for all the samples ranged between 216 and 1012mg/L and samples $S_{5,}$ S_{10}, S_{11},S_{16} and S_{19} were not satisfactory. Only samples S_5 and S_7 were satisfactory for all the three parameters tested for biological properties, although they had failed the examination for physical properties. The groundwater quality of the shallow wells examined in the present study were found to be contaminated

KEYWORDS: Groundwater, Landfills, Leach Ate, Wells

INTRODUCTION

Often times, pollution occurs as a result of the interaction of man with his environment. As expected, he generates and always has to dispose of waste. Very often, the concern is with the disposal of solid waste, due to its volume and the possibility of contamination if left to degrade unattended.

Land filling is the oldest and most popular form of disposing solid waste,[1].It has been more popular, supposedly because of the simplicity and versatility of its procedure, using different materials in the impervious layers and also as covering, [2]. However, quite often, the supposedly impervious layers are pervious to flowing matter such as liquids, also called 'leach ate'[3, 4]. The intrusion of leach ate impairs the quality of groundwater[5], but a well-designed` and properly operated sanitary landfill could be used to effectively dispose of solid waste, such that the leach ate produced does not adversely influence the quality of groundwater. Hence, the selection of a site is considered as the most important stage in the land filling of solid waste, [6].

Water is characteristically clear, odorless and tasteless in an unhampered state. It is versatile, hence could be put to a variety of uses. It is also considered a universal solvent [7], thus it is rarely clean and may have varying properties[8]. Water may be considered relatively inexpensive and the most abundant molecule on the earth's surface as it comprises 70-75% of the earth's surface in both the liquid and solid states. Water also occurs in the atmosphere as vapor. The importance of water cannot be over emphasized. Despite the seemingly abundance of water, potable water is yet scarce.

Hence, the Millennium Development Goals (MGD’s) drove progress in several important areas including access to improved sources of water, the unfinished job which is continued in the Sustainable Development Goals (SGD’s). Water is considered indispensable to life and existence. The provision of potable water is a challenge that is bigger and more felt in the rural areas or the underdeveloped and developing nations.

Lagos mainland, the study are is a local government area (LGA) in the Lagos division of Lagos state. It is located on coordinates 6.5084^{o}N, 3.3842^{o}E in the south-west of Nigeria. On the basis of land area and physical characteristics, Lagos state can be broadly divided into two, namely; the highland and the mainland. By nature, Lagos state is blessed with and surrounded by several bodies of surface waters such as the ocean, sea, lake, river, stream, beach, canal and pond. By extension therefore, the mainland is also surrounded by water. The mainland is densely populated and often considered as the downtown part of the city, compared to the upscale island of Lagos. The Lagos mainland includes areas like Ebute metta, Makoko, Oyingbo, Oto, Oko-oba etc.

Sanitary landfill is the means of solid waste disposal used in the mainland LGA. Solid waste comprises all waste arising from human and animal activities that are normally solid, and considered as useless and unwanted. The collection and management of solid waste in Lagos state is carried out by the Lagos state waste management Authority (LAWMA).

Although surrounded by surface waters, and there are existing pipe borne water distribution systems, yet it is extremely difficult to get potable water for drinking and other domestic uses. Therefore, the inhabitants of the mainland depend on ground water basins for their water supply. Due to the proximity of the water table to the ground level (surface), shallow wells are more common in this locality. But there are greater chances of pollution of shallow wells, especially from dumps and landfills as considered in this study.[9, 10], in the review on groundwater contamination near municipal solid waste landfill, concluded that leachates caused serious contamination of groundwater and the quality of groundwater close to landfills was “very bad”.

This study therefore aims to investigate the influence of a possible leach ate intrusion from the landfills on both the physical and biological integrity of water from the shallow wells within the study area.

MATERIALS AND METHODS

In this study, twenty (20) well points were randomly selected from shallow wells located adjacent to landfills within the various localities in the study area. The points were labelled S_1-S_{20}. Water was collected from each point by means of a fetcher which was previously washed and thoroughly rinsed with distilled water prior its use. Four (4) litre size plastic containers for the collection and storage of samples were also washed, thoroughly rinsed and labelled S_1-S_{20}in accordance with the sampling points. Samples collected were immediately taken to the laboratory for further analysis. Remaining samples were kept cold during the time elapsed between collection and analysis, to slow down the rate of chemical reactions and phase change, but were analyzed as soon as possible.

The preliminary experiments involved determination of physical properties on site, immediately after sample collection to analyze the physical parameters that may not be stable, such as temperature and pH. It also included more trials of the main experiments that were carried out in the laboratory.

The apparatus used in the experimental were all thoroughly washed and cleaned with distilled water prior their use, to exclude external influence on the results. They were again rinsed with a portion of the sample to be analyzed.

The preliminary experiments were first conducted; further experiments were yet conducted as the main experiments. Appearance, temperature, odor, pH, color, odor, and TDS were the parameters analyzed for under the examination for physical properties, while the total plate count, total coli form count and confirmatory fecal coli form test were conducted for the biological properties.

RESULTS AND DISCUSSIONS

Although the ground has the capacity to filter out particulate matter naturally, hence the groundwater will usually appear clear and clean, yet the results showed all samples to appear to contain particles giving it a cloudy appearance except samplesS_1, S_2, S_3 and S_{17}which had a clear appearance as presented in Table 1.0. This could be due to the nearness of the water table to the ground surface as is typical of shallow wells and nearness to the landfill, a source of pollution and the migration of contaminants at different layers [11, 12]. The ground is therefore unable to sufficiently filter out the particles.

All the samples had temperatures below the 40^{o}C standard. In Table 1.0, the pH of samples were within neutral to slightly alkaline except samples S_3, $S_{15}$and S_{19} which were slightly acidic at pH 5.57, 5.19 and 6.12 respectively. They fell outside the acceptable limit of the World health organization (WHO) standard (i.e. 6.5-8.5). Although certain soil and bedrock are naturally acidic, causing acidity in the groundwater, as it passes through them. Percolated acidic water from acid precipitation is also a probable cause. Acidity in water is not a health concern, but over time, it can cause corrosion in plumbing and water heating appliances [13, 14].

Of all the twenty samples, only sample S_3 was with odor and indicated as objectionable in Table 1.0. Rusty or 'rotten egg' like odor in well water may be due to bacteria problems. Also, odor-producing bacteria are often referred to as "iron" or "sulfur-reducing" bacteria, using iron or sulfur and giving off hydrogen sulfide gas (i.e. rotten egg odor) in their life cycle. Their presence may sometimes indicate the presence of disease-causing bacteria. They may not constitute a health risk in the immediate timeout, may multiply rapidly and cause odor problems once introduced into a well. Also, they may form slimy colonies in toilet tanks and pipes and may stain laundries. It is noteworthy that a rotten egg odor may also come from the rock origin in which the well was drilled; in which case, the odor is present when the well is first used and may decrease over time. Odors that come in later is thought to be from bacterial growth and may appear suddenly. Odor in water is objectionable [15]

The analysis for color showed all samples but S_5, S_{16} and S_{19} to be within the standard (i.e. 5 Hazen).Only samples $S_{5,}$ S_{10}, S_{11},S_{16} and S_{19} exceeded the WHO standard for total dissolved solids (i.e. 500mg/L). In related studies, groundwater samples were also colored due to proximity to pollution sources [12, 16, 17]

Results of the analysis for biological test presented in Table 2.0 also show contamination. Only samples S_5 and S_7 were biologically satisfactory, passing all the three parameters tested. Although all the remaining 18 samples failed both total plate count and total coli form count, however, samples S_1, S_4 and S_{16} were the only ones that failed the test for confirmatory fecal coli form test. There has been similar findings of microbial contamination of shallow groundwater [18].

CONCLUSIONS

Only two samples (i.e. S_5 and S_7) passed all three of total plate count, total coli form count and confirmatory fecal coli form test in the examination for biological properties, but failed the tests for physical properties including; pH, color, odor, appearance and total dissolved solids. Therefore the groundwater quality of all the shallow wells examined in the present study show contamination.

Table 1.0: Physical Properties

Characteristics	Samples																			
Samples	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}
Appearance	C	C	C	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl	C	Cl	Cl	Cl
Temperature(°C)	26.4	26.6	26.5	26.9	26.4	26.2	26.5	26.5	26.4	26.3	26.4	26.8	26.9	26.4	26.2	26.2	26.5	26.3	26.5	26.9
pH	7.15	7.09	5.57	7.07	7.40	7.08	6.63	6.73	7.41	7.24	6.52	6.55	7.11	6.90	5.19	8.01	7.13	6.80	6.12	7.09
Odour	NO	NO	OB	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Colour(Hazen)	4.1	4.9	5.9	9.9	6.2	4.7	10.1	11.6	13.0	7.9	6.3	5.1	5.2	8.0	5.1	13.2	4.9	7.9	11.1	5.7
TDS(mg/L)	320	216	409	415	500	715	309	410	470	511	418	512	418	500	355	1012	480	461	1006	316

+

Legend

S_1-S_{20}	Samples
C	Clear
Cl	Cloudy
NO	Non-objectionable
OB	Objectionable
TSS	Total suspended solids
TDS	Total dissolved solids

Table 2.0: Biological Properties

Characteristics	Samples																			
	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}
Total plate count	50	4	25	30	0	10	0	5	16	25	22	8	11	15	5	32	21	21	16	7
Total coli form count	>2,400	2,400	920	2,400	0	29	0	6	2,400	950	920	2,400	17	16	2,400	2,400	11	14	14	16
Confirmatory faecal coli form test	+ve	-ve	-ve	+ve	Nil	-ve	Nil	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve	-ve	-ve	-ve

Legend

-ve	Negative
+ve	Positive
Nil	None

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