ASSESSMENT OF WASTEWATER CHARACTERISTICS AROUND FEDERAL POLYTECHNIC OKO, ANAMBRA STATE.

Fortune .C. Onyia, Franklin .C. Nwolum and Pascal. O. Egbo
Email: forunec57@gmail.com and Chyke113@yahoo.com
Civil Engineering Technology Department,
Federal Polytechnic Oko, Anambra state. 08061262745

***Abstract**: This study is on the assessment of the characteristics of raw sewage around Federal Polytechnic Oko, Anambra State. Samples of raw sewage were taken from a residential source and commercial source. The following parameters were tested; Turbidity, Total Dissolved Solid, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Organic Carbon and pH. The results from the commercial source are: Turbidity, 2228 NTU, Total Dissolved Solid 112 mg/l, Chemical Oxygen Demand (COD) 16426.6 mg/l, Biochemical Oxygen Demand (BOD) 238mg/l, Total Organic Carbon 0.79% and pH 6.63. The result from the residential source is: Turbidity 64.01 NTU, Total Dissolved Solid 52.60 mg/l, Chemical Oxygen Demand (COD) 1061.30 mg/l, Biochemical Oxygen Demand (BOD) 32 mg/l, Total Organic Carbon 0.32% and pH 4.65. The result shows that the sample from a commercial source has a higher strength compared to the sample from a residential source. When compared with World Health Organization (W.H.O) standard, it was observed that Turbidity and Total Organic Carbon are more in the sample from commercial source (2228.00 NTU and 0.79%) when compared with the standard (500 NTU and 0.75%). It was also observed that the sample from the residential source (64.01 NTU and 0.32%) where within or below the World Health Organization (W.H.O) standard. From the results, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and pH of the sample from residential and commercial sources are above the W.H.O standard. This shows that a conventional treatment method can be conveniently adopted/recommended for treatment of any wastewater collected from the location.*

Keywords: Wastewater, Sewage, Characteristics, and Sewage load

Introduction

The water we use never really goes away. In fact, there never will be any more or any less water on Earth than there is right now, which means that all of the wastewater generated by our communities each day from homes, farms, businesses, and factories eventually returns to the environment to be used again.

So, when wastewater receives inadequate treatment, the overall quality of the world's water supply suffers. The ease with which this treatment is carried out depends greatly on the characteristics of the wastewater. Locally, the amount of wastewater homes and communities produce, its characteristics, and how it is handled can greatly impact residents' quality of life. Wastewater has the potential to affect public health, the local economy, recreation, residential and business development, utility bills, taxes, and other aspects of everyday life (Masters, 1994).

Prior to the mid-1800s, human and other wastes usually were just dumped or conveyed to the nearest body of water without treatment. As a result, groundwater and other sources for drinking and bathing were regularly contaminated with sewage.

Epidemics of cholera, typhoid, dysentery, and other waterborne diseases killed thousands, and outbreaks were especially devastating in densely populated areas. After 1854, when the connection between a cholera outbreak and sewage-contaminated water was first discovered, better attempts were made to treat and dispose of sewage separately from drinking water. In many arid and semi-arid countries water is becoming an increasingly scarce resource and planners are forced to consider any sources of water which might be used economically and effectively to promote further development (United State Environmental Protection Agency, USEPA, 2002).

In Nigeria, the same trend has been in existence. The disposal of untreated wastewater has always impacted negatively on the state of quality water. Ignorance, of the various characteristics of wastewater has been one of the challenging occurrences in Nigeria (Mendie,2005). This has made this study necessary since the understanding of the characteristics of wastewater greatly helps to know the appropriate treatment method that can be adopted. Also, Characterization of sewage is essential for an effective and economical waste management programme. It helps in the choice of treatment methods, deciding the extent of treatment, assessing the beneficial uses of wastes and utilizing the waste purification capacity of natural bodies of water in a planned and controlled manner (Siddiqui, 1975).

Materials and Methods

Method for pH Test

The pH was measured by Electrometric Methods using Laboratory pH Meter Hanna model H1991300 (American Public Health Association Standard (APHA), 1998). The electrodes were rinsed with distilled water and blot dry. The electrodes were then rinsed in a small beaker with a portion of the sample. Next, a sufficient amount of the sample was poured into a small beaker to allow the tips of the electrodes to be immersed to a depth of about 2cm. The electrode was at least 1cm away from the sides and bottom of the beaker. Then the temperature adjustment dial was adjusted accordingly. After that, the pH meter was turn on and the pH of sample recorded.

Determination of Total Dissolved Solids

The Total dissolved solid was determined in accordance with American Public Health Association Standard (APHA 25 10 ATDS 139 tester (APHA; 1998). Firstly, the fiber disc was prepared by placing it, wrinkled side up, in the filtration apparatus. Vacuum was applied and the disc washed with three successive 20ml washings of distilled water. Continuous suction was then applied to remove all traces of water. A clean evaporating dish was heated to 180 ± 2^0C in an oven for I hr, Cooled and stored in a desiccator until needed. It was usually weighed immediately before use. A sample volume was chosen to Yield between 2.5 and 200mg dried residue. A portion of the sample which was about 50ml of well mixed sample was filtered through the glass-fiber filter; it was washed with three successive 10ml volume of distilled water, allowing complete draining between washings. Suction was continually applied for about 3mins after filtration is complete. Then the Filtrate was transferred to a weighed evaporating dish and evaporated to dryness on a steam bath. Lastly, the evaporating dish was finally dried for at least 1hr in an oven at 180 ± 2^oC, cooled in a desiccator to balance temperature and weigh.

Determination of Chemical Oxygen Demand

A portion which is about 15ml of the sample was poured into a 250 beaker. Next was the addition of about 2.5ml standard 5% K_2CrO_4 digestion reagent slowly followed by gentle mixing of the solution. Also Added was 3.5 ml of conc. Sulphuric acid reagent through the side of the tubes until it got to the bottom. With the instrument Capped, the contents was mixed thoroughly after which it was Transferred into water bath and heated at 50ºC. Additional distilled water was added to the mixture to make the volume to 50ml followed by the addition of 1-2 drops of phnanthronlein indicator. Finally, a Titration of the mixture was done with 0.05m ferrous ammonium sulphate solution (Morh) salt.

Determination of Biochemical Oxygen Demand by Winkler Method.

The Winkler method of analysis was used (1996). The stopper was carefully removed from the sample bottle and $1cm^3$ Manganous Sulphate solution was added followed by $1cm^3$ alkaline-iodide-azide solution. When introducing those reagents into the full bottle of sample, the tip of the pipettes was wiped below the surface of the liquid. The stopper was replaced carefully after each addition so as to avoid inclusion of air bubbles. The content was mixed thoroughly by inversion and rotation until a clear supernatant water was obtained. About $1cm^3$ conc. Sulphuric acid was added with the tip of the pipette below the level of solution and again the stopper was replaced. The solution was Mix well by rotation until the precipitation has completely dissolved and $100cm^3$ of the solution was pipetted into $250cm^3$ conical flask and immediately titrated against standard Sodium Thiosulphate (0.025mol/dm^3) using freshly prepared starch solution as the indicator (add when solution becomes pale yellow). The titration was in duplicate.

Determination of Total Organic Carbon

A piece of 5g scoop of soil was placed into a tarred 20-ml beaker. It was dried for 2hrs (or longer at 105ºC) and the weight was recorded to±0.001g. With the oven heated to a temperature of 360ºC, the Sample was left to remain in the oven at 360ºC for 2hr.after that, the sample was left to Cool to < 150ºC and the weight was recorded to ±0.001g, in a draft-free environment.

Comparison with World Health Organization (W.H.O) Standard

The results obtained were compared with the standard for World Health Organization as contained in their report and some literatures. From the World Health Organization (1971) international standards for drinking-water, 3rd Edition, Geneva, the limiting values for the various sources of wastewater where compared with the results obtained in the samples. The difference between the values obtained and the one specified by W.H.O where used to make logical definition of the state or quality of waste in the study area.

Results and Discussion

Raw sewage is >99% water. It is gray in color and has an earthy, musty odor. The two samples collected were tested and the results are as tabulated below.

TABLE 1: Waste Water Characteristics of Federal Polytechnic Oko Samples.

Parameters	Sample (A) Residential Buildings Source	Sample (B) Commercial Source
Turbidity NTU	64.01	2228.00
Total dissolved Solid mg/l	52.60	112.00
Chemical Oxygen Demand mg/l	1061.30	16426.60
OD1 mg/l	11.10	19.20
OD5 mg/l	9.60	7.30
BOD mg/l	32.00	238.00
Total Organic Carbon%	0.32	0.79
pH	4.65	6.63

TABLE 2: Comparison of Results with W.H.O STANDARD.

Parameters	World Health Organization Standard	Sample (A) Residential Building Source	Sample (B) Commercial Source
Turbidity NTU	500	64.01	2228.00
Total dissolved Solid mg/l	250	52.60	112.00
Chemical Oxygen Demand mg/l	250	1061.30	16426.60
OD1 mg/l	6	11.10	19.20
OD5 mg/l	6	9.60	7.30
BOD mg/l	30	32.00	238.00
Total Organic Carbon%	0.75	0.32	0.79
pH	6.0-90	4.65	6.63

(W.H.O, 2006)

Discussion

To describe the metabolism of microorganisms and oxidation of organic material, it is necessary to characterize quantitatively concentration of organic matter in different forms (Maiti, 2001). In view of the enormous variety of organic compounds in sewage it is totally unpractical to determine these individually. Thus a parameter must be used that characterizes a property that all these have in common.

Raw sewage discharges may vary in strength and volume depending on the source. Of special concern are slug loads that can upset or pass through the treatment plant. High levels of BOD, TSS, phosphorus, ammonia, and grease can affect treatment. High or low pH can also be a problem.

From the results of the two samples, the sewage from the commercial (2228NTU) source has more turbidity than the one from the residential source (64NTU). This shows that any wastewater from the commercial source is highly turbid.

In terms of the total dissolved solid, the one of commercial source has 112 mg/l against 52.6mg/l of the one from residential source. This still shows the strength and content of sewage from a commercial source to be high.

The BOD for the residential building is 32mg/l and that of commercial source is 238mg/l. This indicates that the level of biological activity in the one from commercial source is higher than the one from residential source.

In terms of the COD and the total organic carbon, the one of commercial source is still higher than that of residential source.

The only point where there is a remarkable difference is in the pH. The one of residential source has 4.65 against 6.63 for the one of commercial source. The value shows that the one of commercial source is tending towards neutrality.

The results obtained for the parameters and tabulated in table 2 below were also compared with World Health Organizations (W.H.O) limiting standards for wastewater reuse (Table 2). It was observed that, turbidity and total organic carbon of the sample from residential source (64.01 NTU and 0.32%) is within the standard (500 NTU and 0.75%) while that of the commercial source (2228 NTU and 0.79%) is above the standard. This shows that the water from residential source has a better quality than the one of commercial source.

The total dissolved solid for the two samples were observed to be below that of the standard. This indicates that in terms of total dissolved solid, they are within the threshold of quality wastewater.

However, among the parameters investigated in the vicinity, three importance parameters in environmental health studies where significantly above the minimum. They are chemical oxygen demand, biochemical oxygen demand and pH.

In environmental health engineering, the chemical oxygen demand (COD) is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution.). A COD test can be used to easily quantify the amount of organics in water. The most common application of COD is in quantifying the amount of oxidizable pollutants found in surface water (e.g. lakes and rivers) or wastewater. The quantity when accurately estimated helps to predict the environmental health of the vicinity. In the case of the study area, a COD value of 1061.30mg/l (residential) and 16426.60mg/l is significantly above the standard which is 250mg/l. These values show that the quality of effluent there is poor and requires serious treatment before any form of reuse. Many governments impose strict regulations regarding the maximum chemical oxygen demand allowed in waste water before they can be returned to the environment. For example, in Switzerland, a maximum oxygen demand between 200 and 1000 mg/L must be reached before waste water or industrial water can be returned to the environment.

Biochemical oxygen demand (BOD) is the amount of dissolved oxygen (DO) needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. In this study, the BOD values are 32mg/l (residential source) and 238mg/l (commercial source) against minimum standard of 30mg/l.

The greater the BOD, the more rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. The consequences of high BOD are the same as those for low dissolved oxygen: aquatic organisms become stressed, suffocate, and die.

The bacteria and other organisms which play an active role in wastewater treatment are most effective at a neutral to slightly alkaline pH of 7 to 8. In this study, the result shows that the waste water from residential source has a pH of 4.65 while the one of commercial source has a pH of 6.63 as against the standard of 6-9. The acidity or alkalinity of wastewater affects both industrial wastewater treatment and the environment. Low pH is acidic, high pH is alkaline, and a pH of 7 is neutral. The values from the study area show that the samples are acidic and therefore pose a threat to activities of microorganisms in that sample though that of the commercial is approximately neutral.

Conclusion

From the dissimilarity in the results obtained from two different locations and literatures, it can be inferred that the characteristics of a raw sewage is dependent on the source producing the sewage. This dissimilarity affects the method of treatment that can be adopted in the treatment process. Hence, the sample from residential building has a lower load and therefore can be efficiently treated using the conventional method of treatment more than that of a commercial source.

Hence, an understanding of the characteristics of raw sewage should be top priority to ensure a safe environment, reduce confusion in the treatment method that may be adopted, reduce the money spent in treating wastewater.

Recommendation

Community-wide water conservation programs should be encouraged since it can result to increased wastewater treatment plant efficiency and savings on energy costs.

References

Carroll, S., Goonetilleke, A., Thomas, E. Hargreaves, M., Frost, R., and Dawes, L. 2006). *Integrated Risk Framework for Onsite Wastewater Treatment Systems, Environmental Management*, 38(2):286-303.

Craun, G.F. (1986) *Statistics of Waterborne Outbreaks in the U.S. (1920-1980)* In: Waterborne Diseases in the United States G.F. Craun. CRC Press, Boca ed pp. 73-159.

Kross, B. (1993). The Nitrate Contamination of Private Well Water in Iowa. *The American Journal of Public Health*. 83: 270, 271.

Maiti, S.K (2001). *Handbook of Methods in Environmental Studies* (Vol 1). Jaipur: ABD Publishers.

Masters, M.Gilbert (1994). *Introduction to Environmental Engineering and Sciences*, New Delhi: Prentice Hall Ltd.

Mendie, U.(2005). *The Nature of Water. In: The Theory and Practice of Clean Water Production for Domestic and Industrial Use. Lagos*: Lacto-Medals Publishers, pp: 1-21.

Plews, G. (1977). *Management Guidelines for Conventional and Alternative Onsite Sewage Systems* --Washington State; p. 187 – 193. In: N. McClelland (ed.), Individual Onsite Wastewater Systems, Proceedings of the third national conference, 1976.

Siddiqui, H.R (1975): *Characteristics of Domestic and Municipal Sewage in India*, Indian Journal Environmental Health 55:85-88.

Standard Methods for the Examination of Water and Waste Water (1998) (20th ed.). APHA.AWWA, WEF, New York.

Squillace, P. J and Toccalina, P. J: (2006). The Quality of Our Nation's Waters: Volatile Organic Compounds in the Nations Ground Water and Drinking Water Supply Wells. USGS Circular, 1292.

(USEPA). February (2002). *Onsite Wastewater Treatment Systems Manual*. United States Environmental Protection Agency EPA/625/R-00/008.

USEPA (2008) *Ground Water Rule Source Assessment Manual, Office of Water* United States Environmental Protection Agency, EPA 815 www.epa.gov/safewater. Retrieved on July 23, 2008.

Yates, M.V. and Yates, S.R. (1986*). Use of Geostatistics to Predict Virus Decay Rates for Determination of Septic Tank Setback Distances*. Applied and Environmental Microbiology, 52 (3): 482.

Yates, M.V. (1987). *Septic Tank Siting to Minimize the Contamination of Ground Water by Micro-organisms*, U.S. Environmental Protection Agency Office of Ground Water Protection, EPA/440/6-87/007.p.9.