Global Journals LaTeX JournalKaleidoscope™

Artificial Intelligence formulated this projection for compatibility purposes from the original article published at Global Journals. However, this technology is currently in beta. *Therefore, kindly ignore odd layouts, missed formulae, text, tables, or figures.*

Correlation of Suspended Solids (Ss) and Permanganate Value (Pv) of Domestic Sewage From an Estate In Warri, Nigeria

Dr. I.E Uwidia[1]

[1] University of Benin, Benin City, Nigeria.

Received: 10 December 2011 Accepted: 3 January 2012 Published: 15 January 2012

Abstract

Samples of domestic sewage obtained from a sewage treatment plant located in Warri, Nigeria were analysed for two pollution characteristics such as suspended solids (SS) and permanganate value (PV). Values obtained from the analysis were used to assess the possible relationship between the two pollution characteristics using correlation and regression analysis. Mean values of the suspended solids (SS) ranged between 200.0mg/l and 380.0mg/l while mean values of the permanganate values ranged between 162.2mg/l and 286.0mg/l. The correlation coefficient, r was 0.9577. The analysis indicates that real, strong and significant linear relationship exists between suspended solids and permanganate value in the domestic sewage

---

Index terms— Correlation, SS, PV, Domestic sewage, pollution, pollution characteristics.

1 Introduction

ver the years man has experienced serious environmental impact of wastewater discharged from various sources. Wastewater from residential area is referred to as domestic sewage. This includes sanitary sewage (excreted waste from humans), kitchen, bath, laundry and floor drain wastes [1].Domestic sewage together with the sewage from commercial and industrial establishments are referred to as municipal sewage [2].

The common constituents of domestic sewage include organic and inorganic matter, solids (both suspended and dissolved) and microorganisms. These substances are present as contaminants and the concentration is normally expressed in milligrams of contaminants per litre of the mixture [3].

Sewage typically contains bacteria, viruses and other parasites which are pathogenic. Such pathogenic organisms are disease causing which grow and multiply fast in the intestinal tracts of their hosts e.g. man animals [4]. The faeces of such infested host or carriers can get into a water supply or swimming area easily by direct discharge of raw sewage into the receiving water (river, stream, lake, ocean etc). Such direct discharge causes sewage pollution and serious epidemics. Examples of such diseases transmitted due to direct sewage disposal are water borne diseases (cholera, Author ? ? : Department of Chemistry, University of Benin, Benin City, Nigeria.

dysentery, diarheoa typhoid hepatitis etc) and water contact diseases (e.g. schistosomiasis, leptospirosis, tularemia etc) [5].

Discharge of sewage into a water body reduces the water quality due to pollution by the wastes in the sewage. The greater the pollution load, the poorer the quality of water [6].

All matter except the water contained in liquid is classified as solid matter. Dissolved solids can be differentiated from suspended solids by filtration [7]. Solids in water are undesirable because they degrade the quality of water. When the solid content of any water is high, additional mechanical and chemical treatment is required and cleaning process becomes more expensive [8].

High levels of solids in water also increase the density of water and reduce the solubility of gases like oxygen. Proteins and carbohydrates are biodegradable contaminants which constitute 90% of the organic matter in domestic sewage. The sources of these biodegradable contaminants include excreta and urine from humans; food wastes from sinks; soil dirt from bathing, washing and laundering; plus various soaps, detergents and other cleansing products. Suspended solids in untreated sewage can lead to sludge deposits and anaerobic conditions in receiving surface waters [9]. The methods of determination are based on the amount of oxygen required to convert oxidizable materials to stable end products. Since the oxygen used is proportional to the oxidizable materials present in the sewage, oxygen measurement therefore serves as a relative measure of the strength of domestic sewage [1].II.

2 Justification of the Study

Suspended solids and permanganate values are pollution characteristics used to assess the pollution strength of domestic sewage [8].

The suspended solids present in domestic sewage are insoluble organic and inorganic particles. They are mainly materials that are too small to be collected as solid wastes. They do not settle in the classifier either. Discharge of suspended solids increases the turbidity of water and causes a long term demand for oxygen because of the slow degradation rate of the organic fraction of the material. This organic material may consist of fat, proteins and carbohydrates [10].

The natural biodegradation of proteins (e.g. milk, eggs, meat etc.) will eventually lead to the discharge of ammonia. Ammonium oxidation into nitrite and nitrate by nitrifying bacteria lead to an extra consumption of oxygen present in the sewage. The amount of suspended solids in waters therefore increases with the degree of water pollution [11].

Permanganate value is a measure of the amount of oxygen obtainable from potassium permanganate needed for the oxidization of easily oxidizable inorganic and organic pollutants present in sewage samples [12].

In acid or alkaline solution, potassium permanganate releases oxygen for oxidation purposes. When a sample is exposed to a dilute solution of acidified potassium permanganate (KMn0 4) in a stoppered bottle, the acidified solution of KMn0 4 releases oxygen which oxidizes easily oxidizable wastes in the sample.2Mn0 4 -+ 6H + 2Mn 2+ + 3H 2 0 + 5 (0) 2Mn0 4 -+ 20H - 2Mn0 2 + H 2 0 + 5 (0)

the unused potassium permanganate can therefore be determined by adding to it excess potassium iodide solution from where equivalent quantity of iodide is then titrated against standard sodium thiosulphate solution [13].2Mn04 -+ 16H + + 10I - 2Mn 2+ +8H20+5I2

III.

3 Objectives of the Study

The objectives of this study are to: i) Determine the concentration of suspended solids and permanganate values of raw domestic sewage ii) Study the relationship between the two pollution characteristics mentioned above iii) Establish the relationship which may be found to exist between the suspended solids and permanganate value in the domestic sewage.

IV.

4 Materials and Methods

5 a) Raw domestic sewage used

The raw sewage was collected from a steady stream of sewage arriving at a Sewage Treatment Plant through a conventional central sewerage system (CSS) in an Estate in Warri, Delta State, Nigeria.

V.

6 Sampling Techniques

Samples were obtained from the treatment plant every week. Six samples were collected per day at one hour intervals starting at 7.00am and ending at 12.00pm. Sampling was most convenient during this period.

Each sample was collected in a clean, well labeled plastic bottle and kept in a refrigerator maintained at 4 0 C. At this temperature, biodegradation is inhibited.

The rate of flow was determined with a flow meter each time a sample was collected. At the end of the sampling period, a composite sample was made by adding together volumes of samples proportional to the rate of flow. The samples were collected in wet and dry seasons which are the major seasons in Nigeria so that the results obtained could give a detailed account of the suspended solids concentration and the permanganate value of the sewage in both seasons. Sewage samples were obtained in the wet season months from April to October and in the dry season months from November to March. The composite samples obtained were used for the determination of the suspended solids and permanganate value.

7 VI.

8 Determinations

The two characteristics were determined as recommended by the Standard Methods for the Examination of Water and Wastewater [14], Standard methods for Water and Effluents Analysis [13] and Bureau of Indian Standards [15].

9 a) Data Analysis

The results obtained were subjected to statistical analysis so as to ascertain whether a significant relationship exists between suspended solids and permanganate values. A correlation and regression test was used to analyse any relationship between SS and PV. Assuming the pairs of characteristics SS and PV are represented as x and y. The regression equation of y on x for PV and SS was represented as y = ax + b [16], [17] where a and b are constants; a being the slope and b, the intercept on the y axis. The correlation coefficient, r was calculated [18], [19]. The mean values of x and y and also the standard deviations were calculated [20].

10 VII.

11 Results and Discussion

Results of the sewage analysis obtained for SS and PV determinations are as shown in Tables 1-3.v v I Ve rsion I 32 (D D D D)

The results in Table 1 depicts the mean values and standard deviations obtained for SS and PV at the studied site between the months of April and October which represented the wet season months. The essence of this is to know the status of the sewage from the treatment plant during the wet season. Table 3 shows the SS and PV results and thus the status of the sewage from the treatment plant for the whole year. Analysis of the results obtained in Tables 1-3 is as shown in Table **??** below. The essence of the analysis is to establish whether there is a relationship between these two characteristics during the wet season, dry season and the entire year. The PV and SS values were determined in both wet and dry seasons so as to examine the pollution strength of both characteristics in the domestic sewage for the whole year.

The results obtained from the analysis reflect the degree of correlation between the suspended solids and permanganate value determined. A comparison of the results in Tables 1 and 2 reveals the effects of both wet and dry seasons on the SS and PV levels in the domestic sewage.

The SS levels ranged between 200.00mg/l and 380.00mg/l, while PV levels ranged between 162.20mg/l and and 286.00mg/l in the wet season months(Table 1). During the dry season months, SS levels ranged between 200.00mg/l and 280.00mg/l while PV levels ranged between 165.00mg/l and 218.40 mg/l(Table 2). This shows that high values occurred for both parameters during wet season while low values were observed for the parameters during dry season.

The high values which occurred for both parameters in the wet season months means that storm water washes various materials (debris, etc.) into the open collection chamber of the treatment plant during rainfall. The debris being washed in will affect the concentration of the parameters determined. The low values recorded for SS and PV in the dry season months show that no debris was washed into the open collection chamber of the treatment plant. The nature, quality and quantity of debris washed into the open collection chamber in each month and the intensity of rainfall would also have taken toll on the PV and SS levels. Table **??** : Data analysis of PV on SS (for the whole year). c) The whole year Figure 3 shows the relationship between permanganate value and suspended solids for the whole year.

12 SS

The slope of the graph (a) was 0.70, the intercept on the PV axis (b) was 21.97mg/l and the correlation coefficient (r) was 0.9377. This also showed strong positive correlation between permanganate value, PV and suspended solids, SS for the whole year. The linear regression equation was PV = a SS+ b.

The linear regressions of PV on SS for the three sections discussed above show high positive correlation. This is significant. The permanganate value reflects the amount of solids present in the system which will be acted upon by the readily available potassium permanganate (i.e. KMn0 4).

The magnitude of the permanganate value obtained depends on the suspended solids present in the sewage and this also depends on the pollution load. Permanganate value therefore provides information about how much suspended solids are present in the sewage sample. Figure 1 shows the relationship between permanganate value and suspended solids during the wet season. The resulting linear equation was PV = a SS + b. The slope of the graph a, was 0.72 and intercept on the PV axis b, was 12.05mg/l. Also the correlation coefficient r, was 0.9304.The value of the correlation coefficient (r = 0.9304), showed that the relationship between PV on SS for the wet season was real, strong and positive.

13 Conclusion

In conclusion, the preceding analysis and discussion show that a real, strong and significant relationship exists between permanganate value (PV) and suspended solids (SS). The linear regression equation is: The regression equation shows that a relationship exists between the suspended solids and the permanganate value in the domestic sewage. [1]

[1] Correlation of Suspended Solids (Ss) and Permanganate Value (Pv) of Domestic Sewage From an Estate In Warri, Nigeria

1

Figure 1: Figure 1 :

2

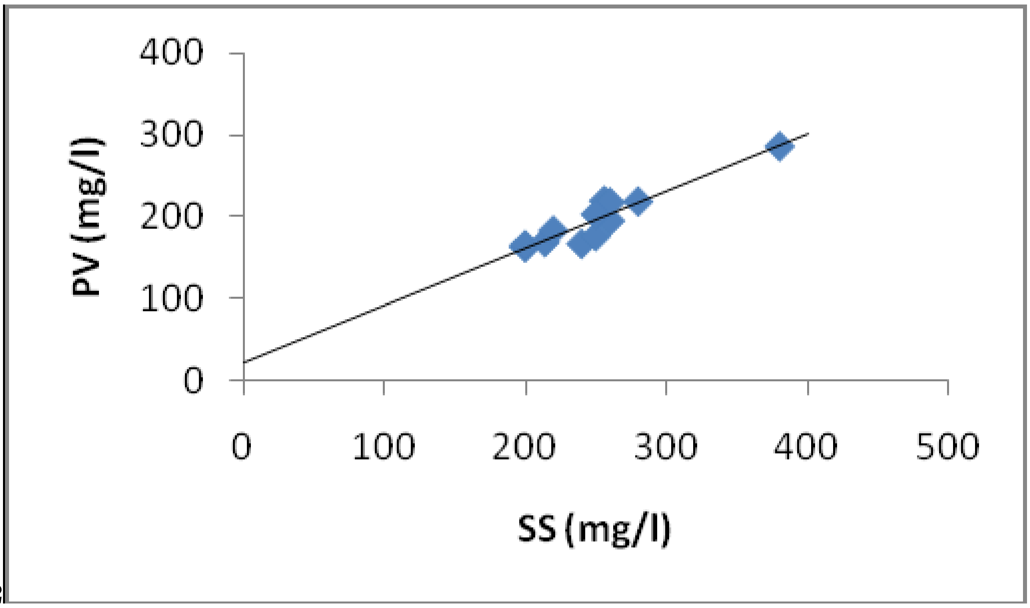

Figure 2: Figure 2 :

2

Figure 3: Table 2 :

3

Correlation of Suspended Solids (Ss) and Permanganate Value (Pv) of Domestic Sewage From an Estate In
Warri, Nigeria

Figure 4: Table 3 :

1

SAMPLE NO.	MONTHS	SS (?x)mg/l MEAN ± SD	PV (v?y)mg/l MEAN ± SD
1	APRIL	380.00±1.89	286.00±34.10
2	MAY	260.00±2.11	194.80±0.43
3	JUNE	240.00±271	166.40±1.26
4	JULY	200.00±2.31	162.20±0.80
5	AUGUST	250.00±189	175.80±5.12
6	SEPTEMBER	256.00±2.98	219.27±0.85
7	OCTOBER	260.00±4.99	217.27±0.19

SAMPLE NO	MONTHS	SS (? x)mg/l MEAN ± SD	PV (? y)mg/l MEAN ± SD
1	NOVEMBER	200.00 ± 2.83	165.00 ± 0.85
2	DECEMBER	214.00 ± 9.09	168.53 ± 0.44
3	JANUARY	220.00 ± 11.03	182.73 ± 0.64
4	FEBRUARY	250.00 ± 1.33	202.73 ± 0.34
5	MARCH	280.00 ± 6.11	218.40 ± 0.57

SAMPLE NO	MONTHS	SS (? x)mg/l MEAN ± SD	PV (? y)mg/l MEAN ± SD
1	APRIL	380.00 ± 1.89	286.00 ± 34.10
2	MAY	260.00 ± 2.11	194.80 ± 0.43
3	JUNE	240.00 ± 271	166.40 ± 1.26
4	JULY	200.00 ± 2.31	162.20 ± 0.80
5	AUGUST	250.00 ± 189	175.80 ± 5.12
6	SEPTEMBER	256.00 ± 2.98	219.27 ± 0.85
7	OCTOBER	260.00 ± 4.99	217.27 ± 0.19
8	NOVEMBER	200.00 ± 2.83	165.00 ± 0.85
9	DECEMBER	214.00 ± 9.09	168.53 ± 0.44
10	JANUARY	220.00 ± 11.03	182.73 ± 0.64
11	FEBRUARY	250.00 ± 1.33	202.73 ± 0.34

Figure 5: Table 1 :

[Ward et al. ()] , A Ward , W Elliot , Hydrology . 1995. Lewis; New York: CRC Press. p. 65.

[MathBits.com) ()] , `Mathbits.com/mathbits/tisection/statistic2/correlation.htm` *Math-Bits.com)* 2000.

[Tchnobanoglous et al. ()] , G Tchnobanoglous , F L Burton , H D Stensel . 2003. Metcalf and Eddy Inc. McGraw-Hill Book Co. p. 134. Wastewater Engineering (Treatment, Disposal, Reuse (4th Edition)

[Tofallis ()] , Tofallis . *Least Square Percentage Regression J. Modern Appl. Statistical Methods* 2009. 7 p. .

[Cohen et al. ()] *Applied Multiple Regression / Correlation Analysis for the Behavioral Sciences*, J Cohen , P Cohen , S G West , L S Aiken . 2003. Hillside, NJ: Lawrence Erlbaum Associates. (2nd Edition)

[Odili and Ajuar ()] *Basic Educational Measurement and Evaluation*, J N Odili , H N Ajuar . 1995. Warri, Nigeria: COEWA Publishers. p. . (2nd Edition)

[Moldan and Cherry ()] *Biogeochemistry of small Catchments, scope 51*, R Moldan , J Cherry . 2007. 1994. New York: Wiley and Sons. p. .

[Uwidia and Ademoroti ()] 'Characterisation of Domestic Sewage from an Estate in Warri'. I E Uwidia , C M Ademoroti . *Nigeria. Int. J. Chem* 2011. 3 p. 3.

[Ademoroti ()] *Environmental Chemistry and Toxicology*, C M Ademoroti . 1996a. Foludex Press Ltd. p. . (Ibadan pp)

[Csuros ()] *Environmental Sampling and Analysis*, M Csuros . 1997. New York: CRC Press LLC. p. .

[Henry and Heinke ()] *Environmental Science and Engineeing*, J G Henry , G W Heinke . 1989. Eaglewood Cliffs, N. J: Prentice Hall. p. 414.

[Methods of sampling and Test for Water and Wastewater 1 st Revision of 15 30025 ICS No. 13.060 Bureau of Indian Standards ('Methods of sampling and Test for Water and Wastewater 1 st Revision of 15 30025 ICS No. 13.060'. *Bureau of Indian Standards (BIS)*, 2005. 50 p. .

[Miroslav and Vladimir ()] *Practical Environmental Analysis. The Royal Society of Chemistry*, R Miroslav , B N Vladimir . 1999. Cambridge, Uk. p. 163.

[Uwidia ()] *Prediction of Five-Day Biochemical Oxygen Demand (BOD 5) Values from More Readily Determinable Pollution Characteristics*, I E Uwidia . 2011. Benin City. p. 42. University of Benin (PhD Thesis)

[Septic Systems, EPA. United States Environmental Protection Agency ()] *Septic Systems, EPA. United States Environmental Protection Agency*, 2011.

[Standard Methods for the Examination of Water and Wastewater 19th Edition ()] *Standard Methods for the Examination of Water and Wastewater 19th Edition*, 1995. New York: American Public Health Association. p. 5210A.

[Ademoroti ()] *Standard Methods for Water and Effluents Analysis*, C M A Ademoroti . 1996b. Foludex Press Ltd. Ibadan. p. .

[Nathabandv and Renzo ()] 'Statistics and Probability for Civil and Environmental Engineers'. T Nathabandv , R Renzo . *Surgapore pp*, 1998. McGraw-Hill Book Co. p. .

[Fish ()] 'Understanding Our Environment: An Introduction to Environmental Chemistry and Pollution'. H Fish . *Freshwaters in*, R M Harrison (ed.) (Cambridge, UK.) 1994. Royal Society of Chemistry. p. .

[Packham ()] 'Water Quality and Health. 2 nd Edition'. R F Packham . *Royal Society of Chemistry* 1990.