American Journal of Environment, Energy and Power Research
Vol. 1, No. 4, June 2013, PP: 94 - 107, ISSN: 2329-860X (Online)
Available online at www.ajeepr.com

Research article

ALLUVIUM STUDIES ON VOID RATIO AND POROSITY OF MICROBES TRANSPORT IN COASTAL AREA OF RIVERS STATE, NIGERIA.

Eluozo,. S. N

Department of Civil Engineering, Faculty of Engineering, University of Nigeria Nsukka.
E-mail: solomoneluozo2000@yahoo.com

Abstract

Alluvium studies on void ratio and porosity of microbes transport in coastal area of Rivers state has been assessed. Alluvium deposition in Rivers State is predominant in entire study area, base on the variation experienced in some part of the study location depositions, it produce a lot of influences that include void ratio and porosity in the entire area of River State. Void ratio and porosity is one of the major influences of fast transport of microbes to ground water aquifer in Rivers State. To determine the rate void ratio and porosity in the study area, sample were collected from a borehole drilling sites and were subjected to thorough laboratory analysis, standard laboratory analysis for porosity and void were carried out, the results of both parameters produce results that shows that both parameters influence the transport of microbes to ground water aquifers, because the results deposited high degree of void ratio and porosity at shallow short depths between three to thirty meters, the study has proof the reason why most area experience serious ground water contaminant, base on the rate of the deposition of high degree of void ratio and porosity at shallow depths, the study is imperative because it has explain the major role of both parameters in microbial transport to ground water aquifers in the study area, it has create a plate form for water engineer and scientist to under stand the influence of contaminant to ground water aquifer in the study area.

Keywords: Alluvium studies, microbes transport, analysis, water aquifers

1. Introduction

Uniformity of stratum is base on geologic history and geomorphology, including the geochemistry that influences the constituent of the formation, the characteristics determines the rate of microbial migration to ground water aquifers. Rivers State treasure base of the nation' is situated about 60 km from the open sea lies between longitude 6o55'E to 7o10'E of the Greenwich meridian and latitude 4o38'N to 4o54'N of the Equator, covering a total distance of about 804 km^2 (Akpokodje 2001). In terms of drainage, the area is situated on the top of Bonny River and is entirely lowland with an average elevation of about 15m above sea level (Nwankwoala, 2005). The topography is under persuading of tides which a consequence is flooding especially during rainy season (Nwankwoala and Mmom, 2007). Climatically, the city is situated within the sub-equatorial region with the tropical monsoon weather characterized by high temperatures, low pressure and high relative dampness all the year round. The mean annual temperature, rainfall and relative dampness are 30oC, 2,300 mm and 90% correspondingly (Ashton-Jones, 1998). The soil in the area is mainly silty-clay with interaction of sand and gravel while the vegetation is an amalgamation of mangrove swamp forest and rainforest (Teme, 2002). Rivers state falls within the Niger Delta Basin of Southern Nigeria which is defined geologically by three sub-surface sedimentary facies: Akata, Agbada and Benin formations (Whiteman, 1982). The Benin Formation (Oligocene to Recent) is the aquiferous formation in the study area with an average thickness of about 2100m at the centre of the basin and consists of coarse to medium grained sandstone, gravels and clay with an average thickness of about 2100m at the centre of the basin and consists of coarse to medium grained sandstone, gravels and clay (Etu-Efeotor and Akpokodje, 1990). The Agbada Formation consists of alternating deltaic (fluvial coastal, fluviomarine) and shale, while Akata Formation is the basal sedimentary unit of the entire Niger Delta, consisting of low density, high pressure shallow marine to deep water shale (Schield, 1978).

The quantity and quality of ground water resources of any region are restricted by the climate and geology of the area. The climate through rainfall and surface water resources ensure steady supply or recharge to groundwater resources of an area in a complex hydrological cycle. The geology of the region determines the aquiferous zones where exploitable groundwater may occur and influences the geochemical Characteristics of the groundwater, amongst other factors such as human activities (Domenico, 1972). The geochemical characteristics of the groundwater in turn influence the quality of the groundwater resources. Earlier works by Demenico, and Schwartz (1998), Ahiarakwem and Ejimadu (2002), Downey (1984), Aniya and, Schoenekeck K (1992), Idowu et al. (1999) and Awalla and Ezeigbo (2002) have confirmed the influence of local geology on the aquifer characteristics and quality of groundwater resources of any area. Human activities may also influence the quality of groundwater in the region (Alagbe, 2006). Groundwater has been described as the main source of potable water supply for domestic, industrial and agricultural uses in the southern part of Nigeria especially the Niger Delta, due to long retention time and natural filtration capacity of aquifers (Odukoya et al., 2002; Agbalagba et al., 2011; Ehirim and Ofor, 2011). Water that is safe for drinking, pleasant in taste, and suitable for domestic purposes is designated as potable water and must not contain any chemical or biological impurity (Horsfall and Spiff, 1998). Pollution of groundwater has gradually been on the increase especially in our cities with lots of industrial activities, population growth, poor sanitation, land use for commercial agriculture and other factors responsible for environmental degradation (Egila and Terhemen, 2004). The concentration of contaminants in the groundwater also depends on the level and type of elements introduced to it naturally or by human activities and distributed through the geological stratification of the area. It has been reported that petroleum refining contributes solid, liquid, and gaseous wastes in the environment (Ogbuagu, et al., 2011). Some of these wastes could contain toxic components such as the polynuclear aromatic hydrocarbons (PAHs), which have been reported to be the real contaminants of oil and most abundant of the main hydrocarbons found in the crude oil mixture (El-Deeb and Emara, 2005). Once introduced in the environment, PAHs could be stable for as short as 48 hours (e.g. naphthalene) or as long as 400 days (e.g. fluoranthene) in soils (Martens and Frankenberger, 1995). They thus, resist degradation and, remain persistent in sediments and when in organisms, could accumulate in adipose tissues and further transferred up the trophic chain or web (Decker, 1981; Schwartz, 2003 Boehm et al., 1981).

2. Material and Method

Sample were collect from a bore hole drilling site for ten locations through method of insitu method of sample collection, ten sample were collected in sequence of three metres each, the sample were subjected to standard thorough analysis for void ratio and porosity, the experiment performed for the two parameters determine the rate of influence on this two parameters for microbial transport to ground water aquifers on alluvium deposition.

3. Results and Discussion

Results and tables on void ratio and porosity are presented in tables and figure shown bellow

Table 1: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 1	Porosity (N)
3	0.24	0.48
6	0.22	0.44
9	0.2	0.4
12	0.13	0.26
15	0.14	0.28
18	0.14	0.28
21	0.11	0.22
24	0.08	0.16
27	0.09	0.18
30	0.07	0.14

Table 2: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 2	Porosity (N)
3	0.36	0.72
6	0.34	0.68
9	0.25	0.5
12	0.28	0.56
15	0.21	0.42
18	0.27	0.54
21	0.13	0.26

24	0.05	0.01
27	0.05	0.01
30	0.06	0.08

Table 2 void ratio and porosity deposition at various Depths

Distance	**void Ratio location 3**	**Porosity (N)**
3	0.8	0.6
6	0.26	0.52
9	0.24	0.48
12	0.3	0.6
15	0.31	0.62
18	0.06	0.12
21	0.03	0.06
24	0.02	0.04
27	0.001	0.002
30	0.04	0.08

Table 3: Void ratio and porosity deposition at various Depths

Distance	**void Ratio location 4**	**Porosity (N)**
3	0.34	0.68
6	0.16	0.32
9	0.17	0.34
12	0.22	0.44
15	0.2	0.42
18	0.38	0.76
21	0.41	0.82
24	0.45	0.9
27	0.45	0.9
30	0.45	0.9

Table 4: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 5	Porosity (N)
3	0.35	0.7
6	0.38	0.76
9	0.17	0.72
12	0.22	0.44
15	0.23	0.46
18	0.19	0.38

21	0.16	0.32
24	0.16	0.32
27	0.16	0.24
30	0.01	0.02

Table 3: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 6	Porosity (N)
3	0.38	0.76
6	0.38	0.76
9	0.29	0.58
12	0.15	0.3
15	0.21	0.42
18	0.28	0.56
21	0.19	0.38
24	0.12	0.24
27	0.11	0.2
30	0.22	0.16

Table 5: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 7	Porosity (N)
3	0.42	0.84
6	0.29	0.58
9	0.23	0.46
12	0.37	0.74
15	0.23	0.46
18	0.15	0.3
21	0.06	0.12
24	0.46	0.04
27	0.44	0.04
30	0.46	0.01

Table 6: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 8	Porosity (N)
3	0.42	0.92
6	0.44	0.88
9	0.37	0.74
12	0.46	0.92

15	0.37	0.74
18	0.33	0.66
21	0.22	0.44
24	0.06	0.12
27	0.06	0.12
30	0.03	0.06

Table 7: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 9	Porosity (N)
3	0.35	0.7
6	0.35	0.7
9	0.33	0.66
12	0.36	0.72
15	0.33	0.66
18	0.26	0.52
21	0.11	0.22
24	0.04	0.08
27	0.07	0.14
30	0.07	0.14

Table 8: Void ratio and porosity deposition at various Depths

Distance	void Ratio location 10	Porosity (N)
3	0.28	0.56
6	0.28	0.56
9	0.36	0.72
12	0.22	0.44
15	0.2	0.4
18	0.16	0.32
21	0.12	0.24
24	0.07	0.14
27	0.03	0.06
30	0.03	0.06

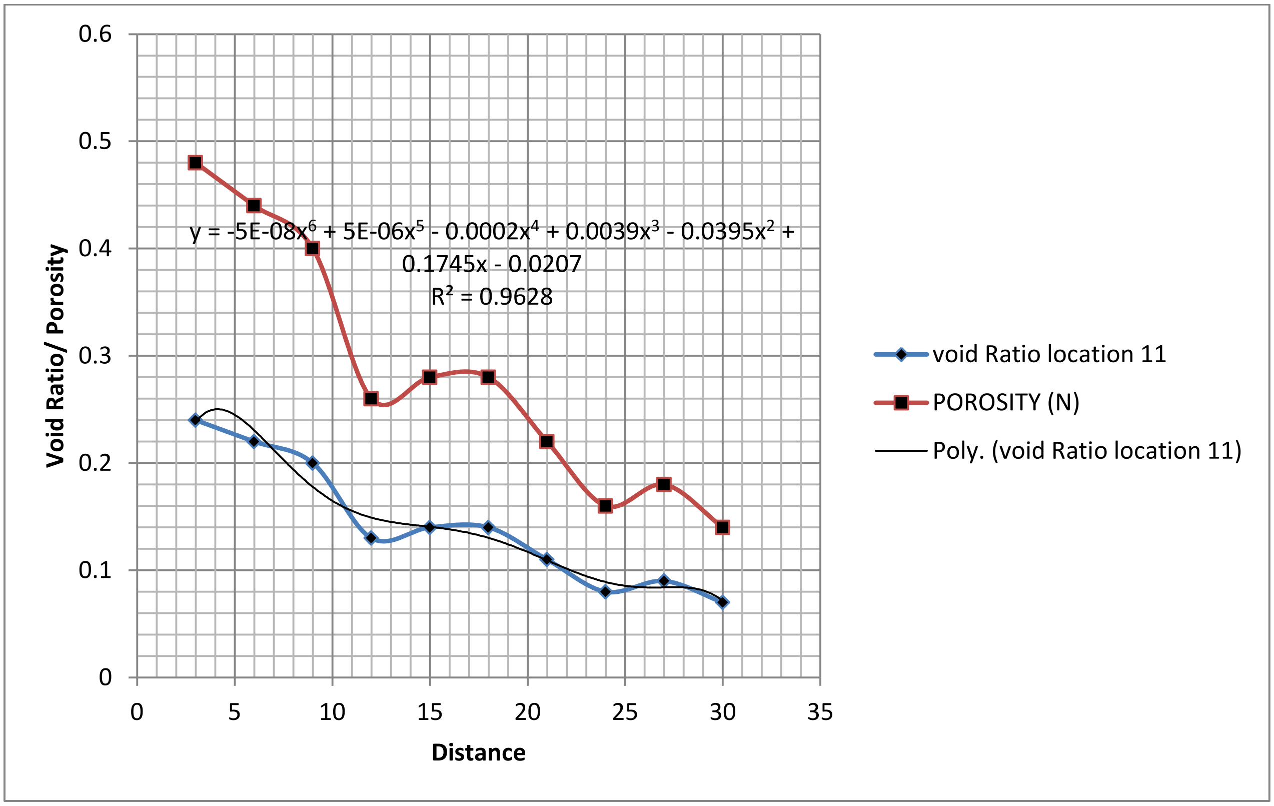

Figure 1: Void ratio and porosity deposition at various Depths

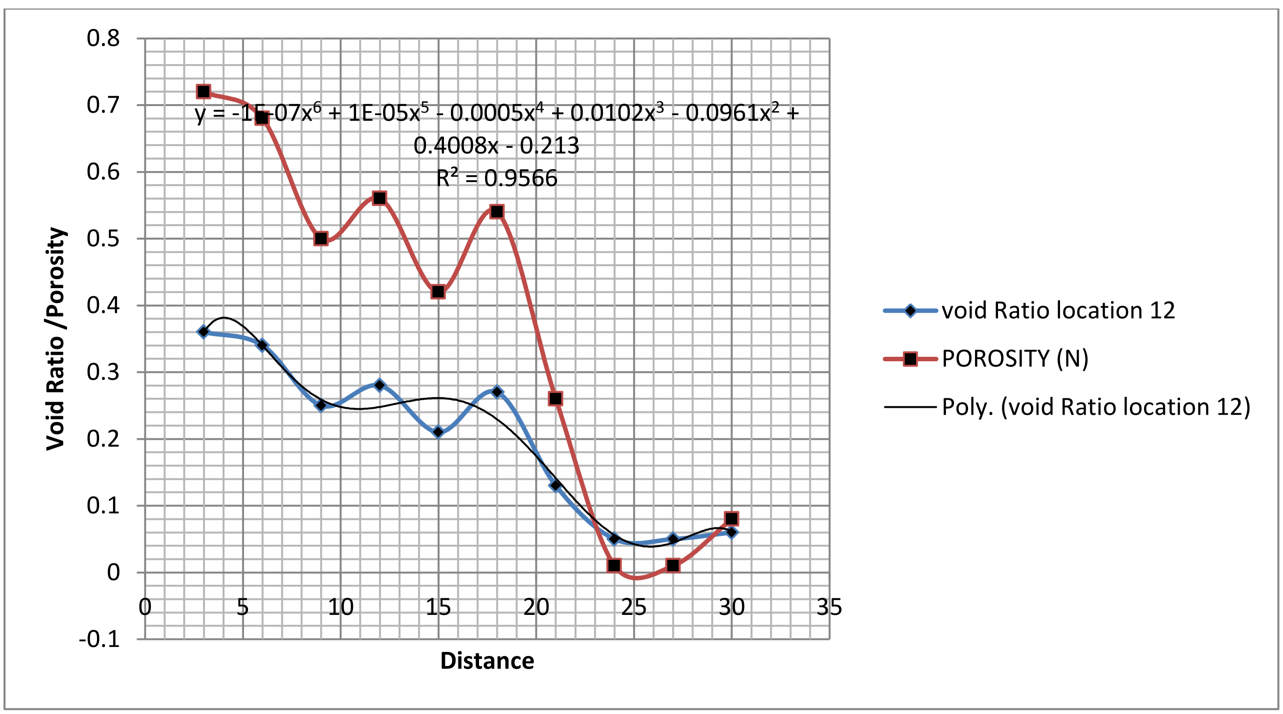

Figure 2: Void ratio and porosity deposition at various Depths

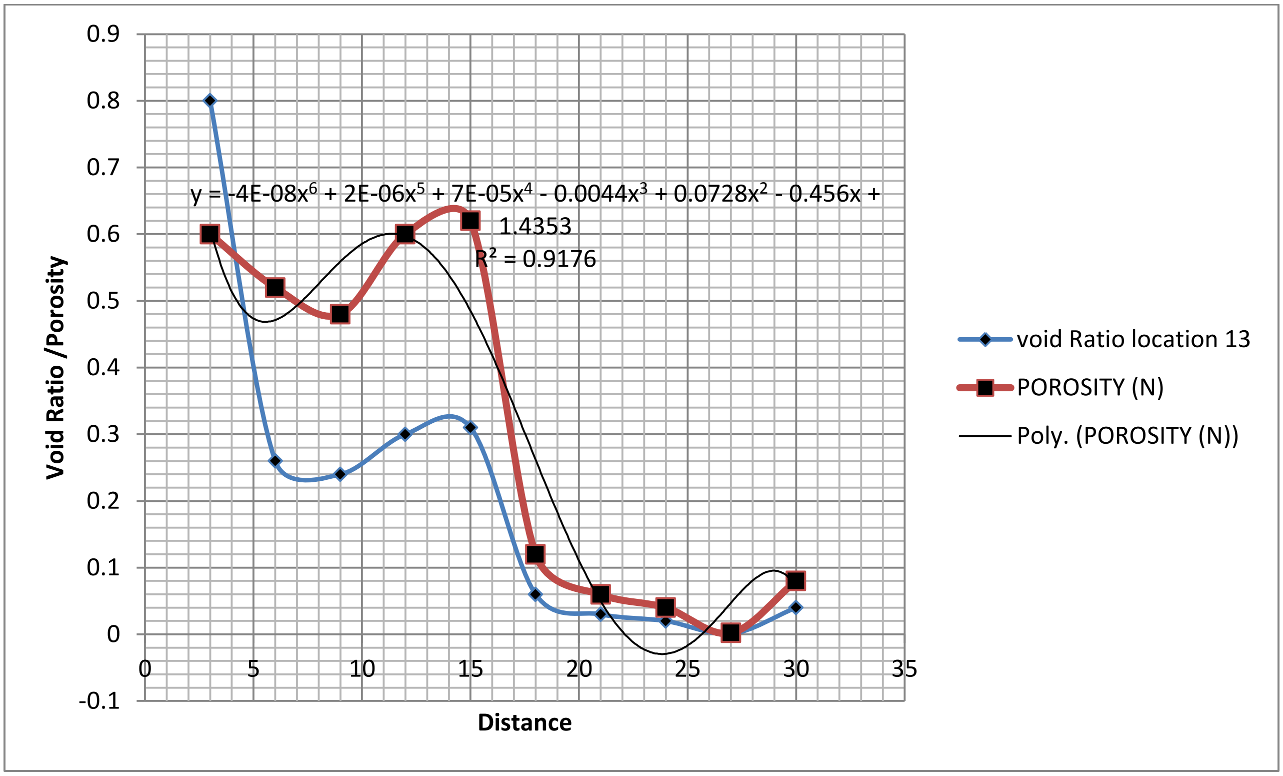

Figure 3: Void ratio and porosity deposition at various Depths

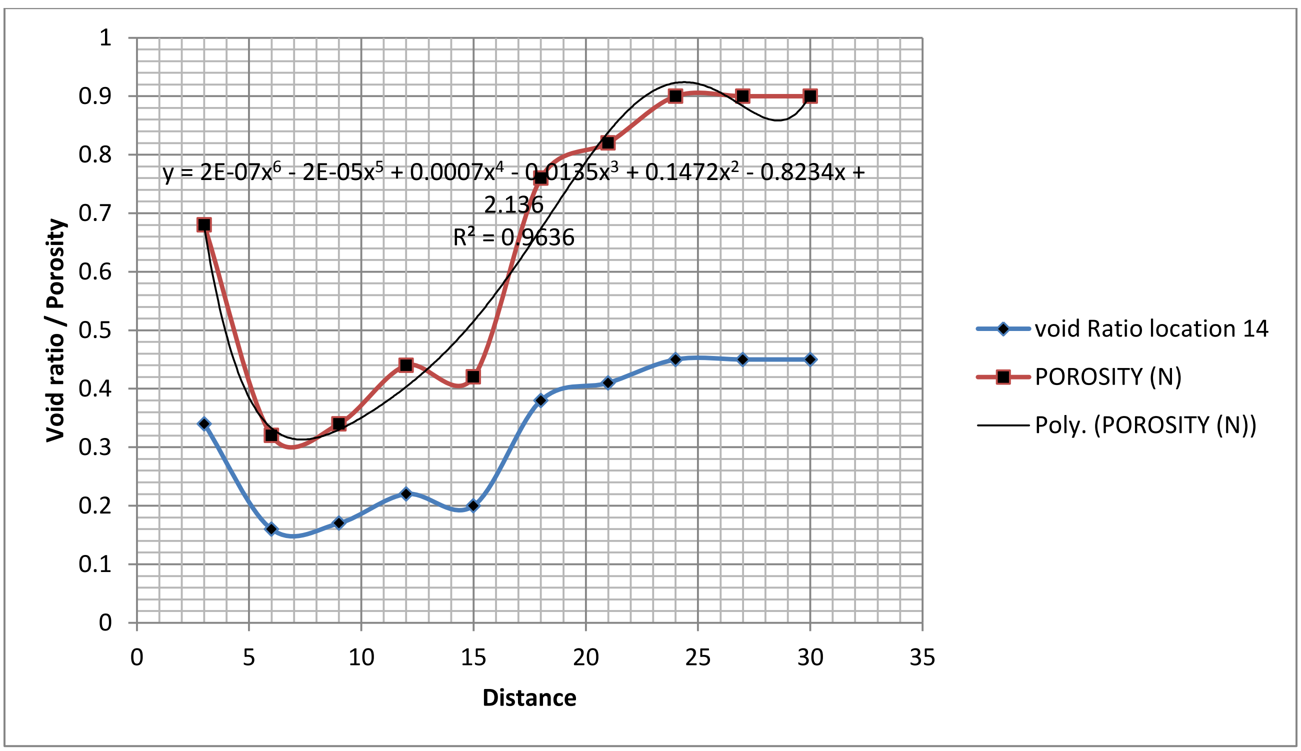

Figure 4: Void ratio and porosity deposition at various Depths

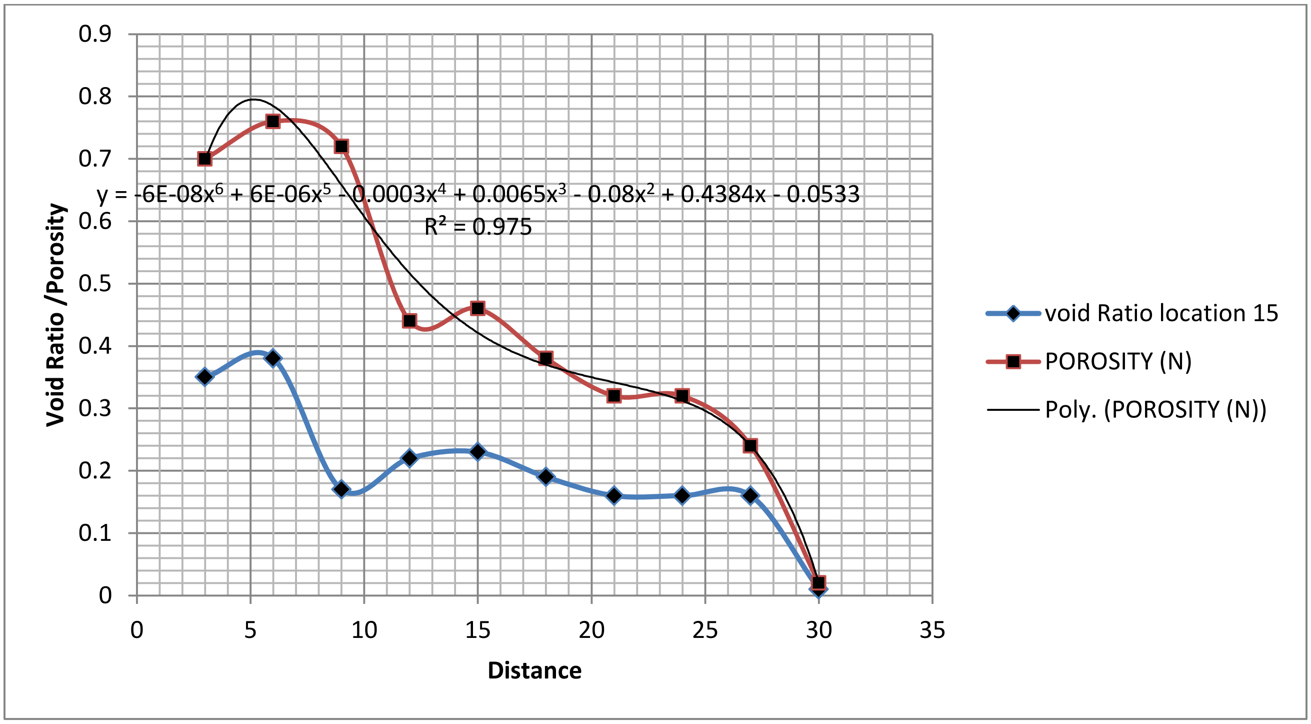

Figure 5: Void ratio and porosity deposition at various Depths

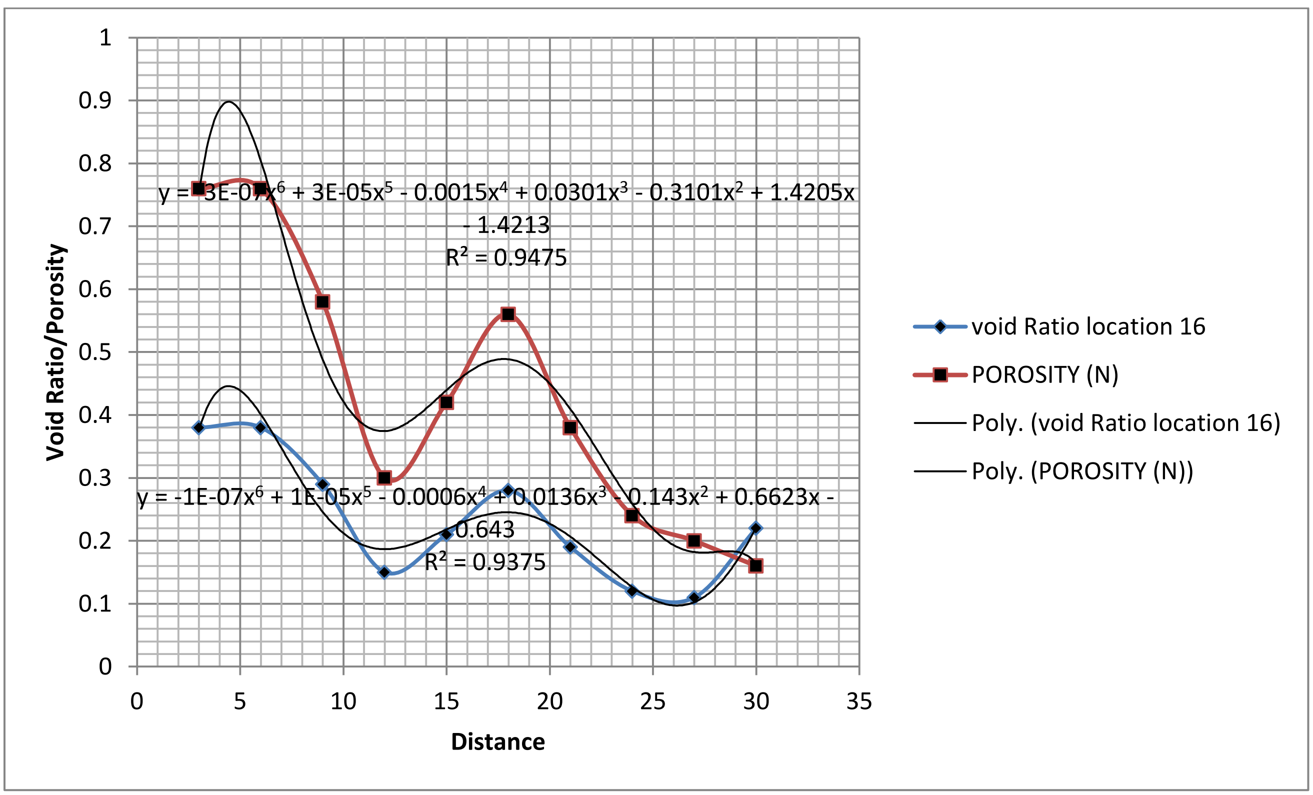

Figure 6: Void ratio and porosity deposition at various Depths

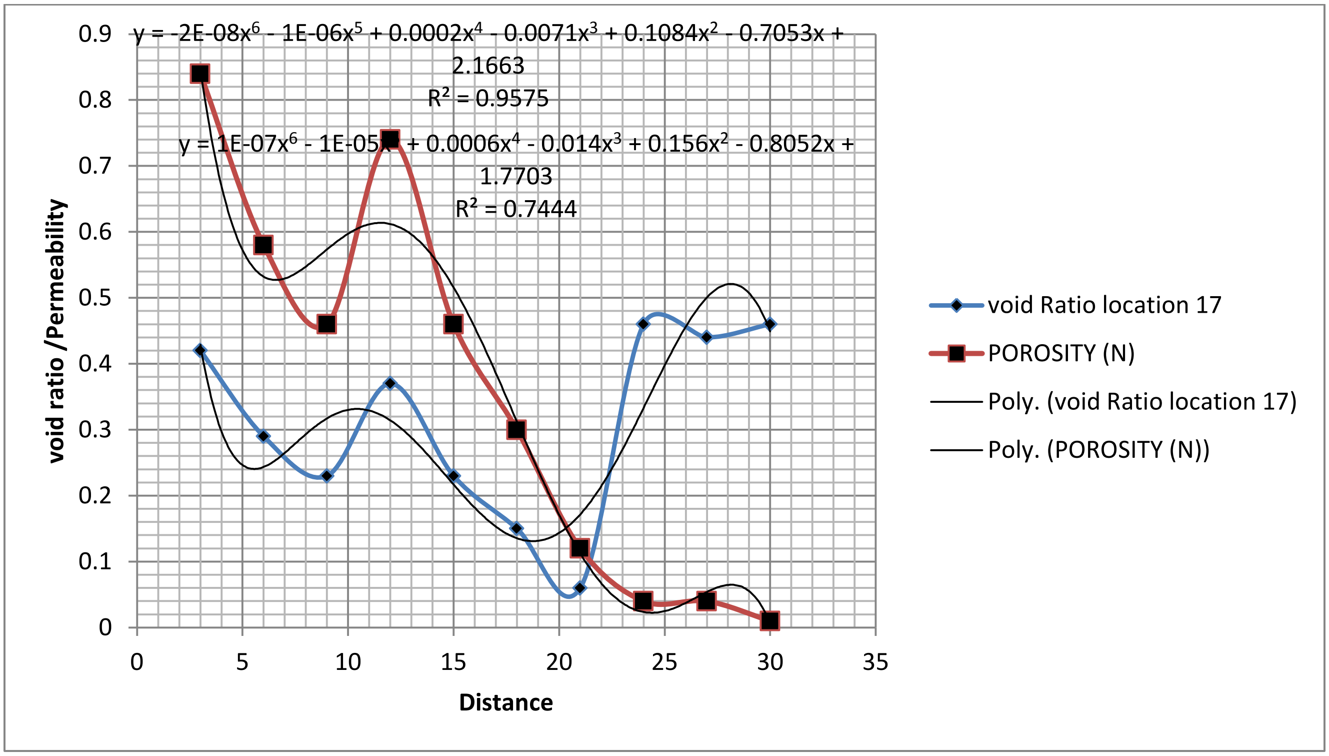

Figure 7: Void ratio and porosity deposition at various Depths

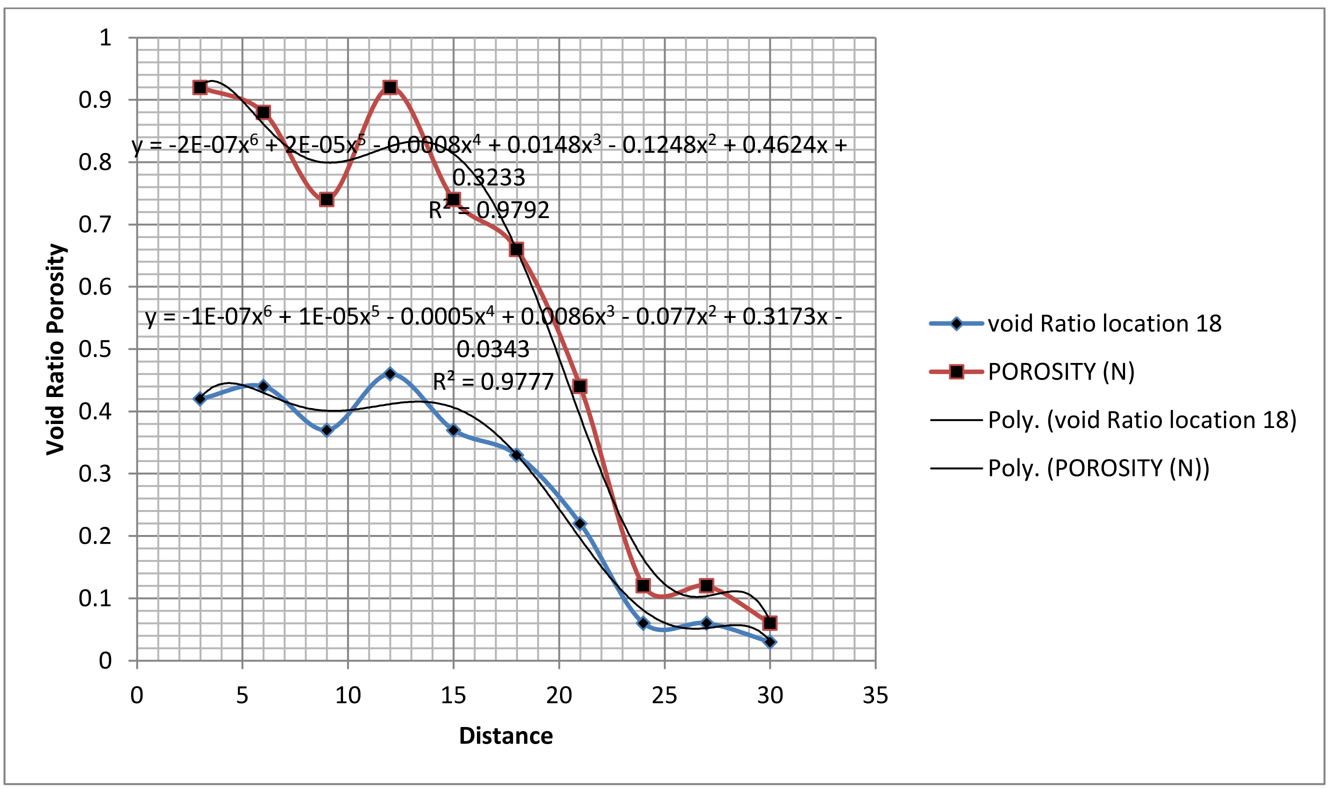

Figure 8: Void ratio and porosity deposition at various Depths

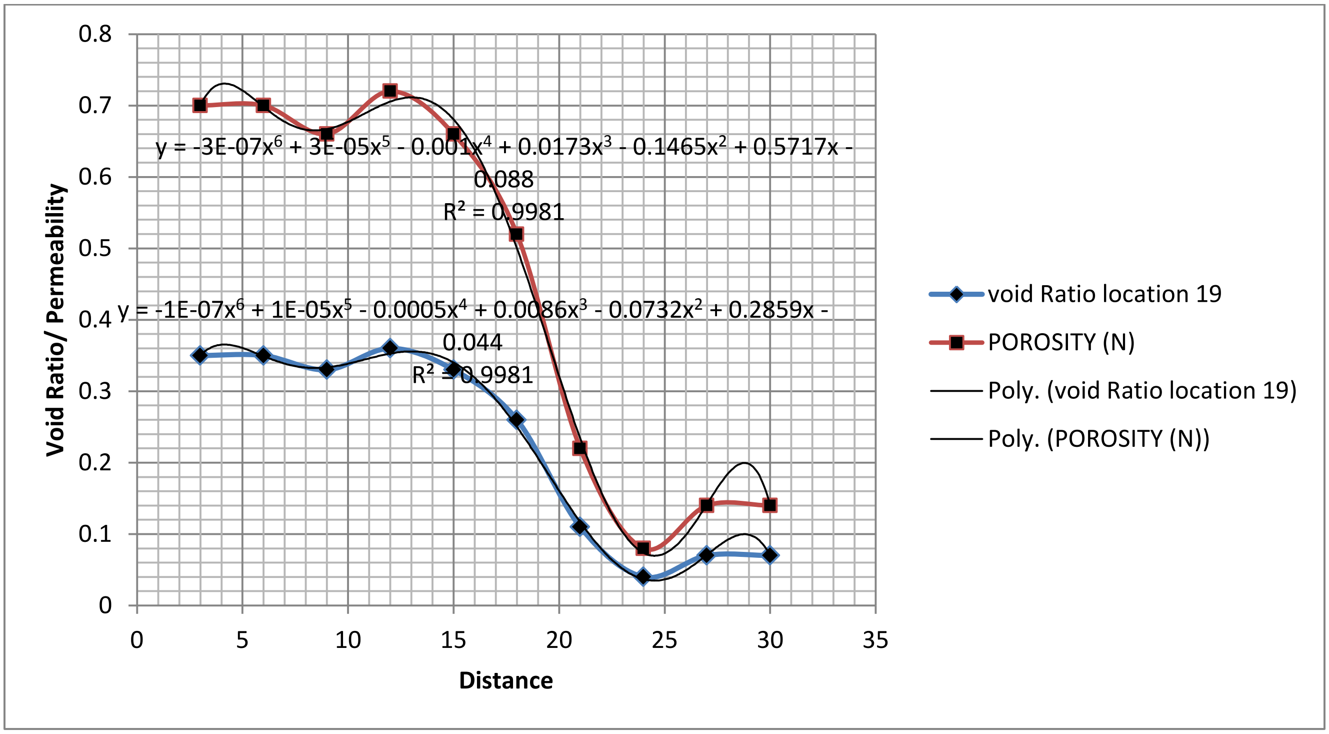

Figure 9: Void ratio and porosity deposition at various Depths

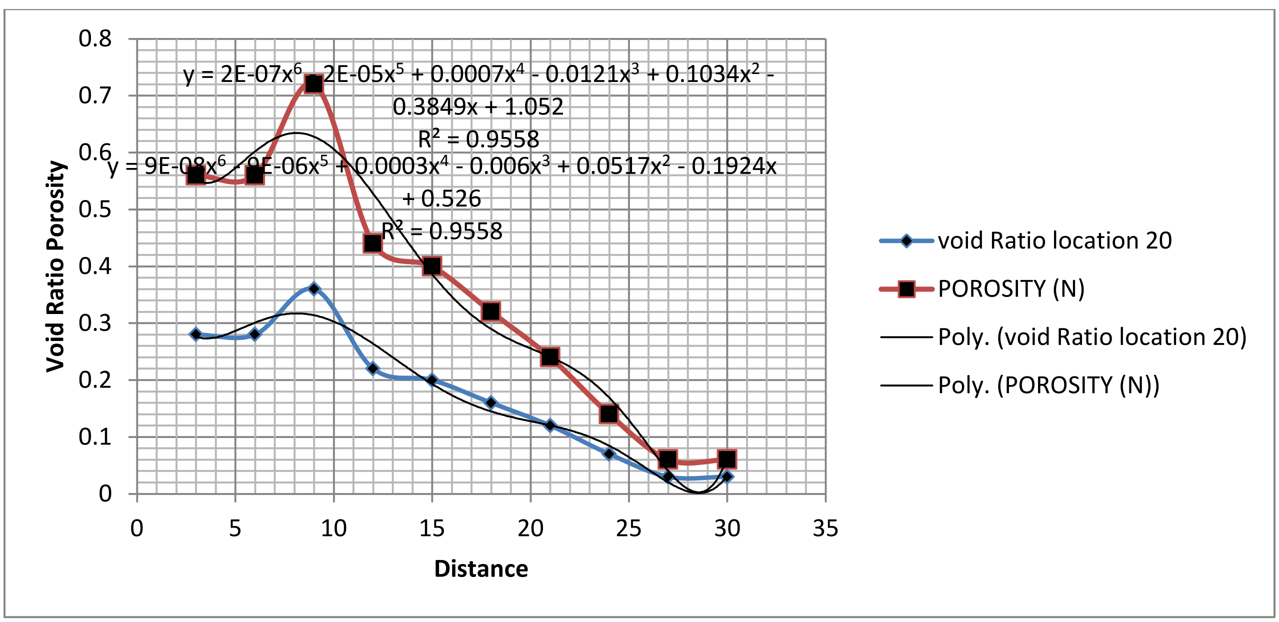

Figure 10: Void ratio and porosity deposition at various Depths

Figure 1 shows that the void ratio increased at three metres and gradually decreased with increase in distance fluctuating to the point where the lowest degree of void ratio was recorded at thirty metres. While porosity in the same vein produced to highest degree of porosity were recorded at three metres and decreased with depth to a point where the lowest degree of porosity were recorded at the same depth. Figure 2, void ratio were found to produce the highest degree at three metres and developed an oscillation between six to eighteen metres and suddenly decrease with increase in distance to the lowest degree of void at twenty-four metres, while porosity result produced the highest degree in oscillation from six to eighteen metres and finally decrease down to thirty metres were the lowest degree of porosity were recorded. Figure 3 produced highest degree of void at three metres and suddenly decreased at six metres, fluctuating down with increase in distance to be the lowest degree were recorded at twenty five metres but developed slight increase at thirty metres. Figure 4 increased with three metres, fluctuating in a continuous increase to were an optimum level were observed at highest degree of porosity from twenty-four to thirty metres, while porosity maintained the same deposition, but were lower in deposition between three to thirty metres slight fluctuation, at the same time the optimum deposited at thirty metres but the void were higher than the porosity. Figure 5 obtained the deposition of void in an oscillation form the optimum were observed at six metres and fluctuates down to the lowest deposition of void, while that of porosity developed the deposition fluctuating down from the highest at six metres down to the lowest level with increase in depth at thirty metres. Figure 6, the void deposited the highest at six metres and suddenly decrease from six to twelve metres and fluctuates from eighteen to thirty metres, while porosity result deposited its degree in the same form, but produced a little variation at thirty, it experienced a slight increase. Figure 7, the void deposited its form of concentration similar to figure 6 the void ratio produced oscillation form between three and twelve and suddenly decrease with distance increase gradually down to where the lowest deposition of void were observed. And porosity fluctuate between three and twelve metres decreases suddenly and finally experienced a serious increase from twenty-one to thirty metres. Figure 8 void ratio experienced fluctuation from three to twelve and finally decreased with distance increase to be lowest deposition that were recorded at thirty metres.

Similarly, the porosity fluctuates between the same depth and in the same vein like void ratio, it decrease with distance increase down to the highest that deposition were recorded at thirty metres. Figure 9 produced similar result like figure 8, the same condition is applicable to both parameters void ratio and porosity. Figure 10 produced its optimum value where the highest degree of void ratio were recorded at nine metres and gradually decreased with distance, increased down to the lowest deposition of void at thirty metres, the same to porosity, but there are some variations in terms of degree of deposition in the stratum. The condition from void ratio and porosity in alluvium deposition explained the experience of the microbes in homogeneous formation, the study location is predominantly of alluvium deposition the microbial transport to ground water aquifer are influenced by alluvium deposition, the behaviour of this microbes to ground water aquifers are influenced by this condition in the study location, furthermore void ratio and porosity has a relationship, both parameters influence the transport of E.coli in phreatic aquifer in the study area.

4. Conclusion

The behaviour of E.coli transport in phreatic aquifer are determine by several condition, but the major influence is the geological deposition in the study area, void ratio and porosity are determine by the deposition of the formation and the entire geological and geomorphology including their geochemistry of the study location, more so the area is underlain by the coastal plain sand, the sediments of the coastal plain sand which were deposited at the late tertiary early quaternary period that is about 2100m thick, and it consist of massive ventricular unconsolidated coarse to medium fine grain sand with localized clay/shale interbreeding. The sand is generally moderated sorted, poorly cemented and angular in shape and have been identified as the fresh water bearing sand. Both confined and unconfined aquifers are encountered at varying depth, the geological details from the study location definitely influenced the deposition of void ratio and porosity, with their level of deposition, it determined rate of transport and deposition of E.coli in ground water aquifers, high rate of void ratio and porosity developed the fast migration of E.coli to ground water in the study area, this condition need to be considered in water resources to avoid ground water contamination.

References

[1] Amadi A.N (2011) effects of urbanization on groundwater quality: a case study of port-Harcourt, southern Nigeria *Natural and Applied Sciences Journal Vol. 11 No*

[2] Akpokodje, G. E., (2001). Hydrogeochemical investigation of groundwater in parts of Niger Delta. Jour. of Mining and Geol. Vol.19, pp 145-150.

[3] Awalla CO, Ezeigbo HI (2002). An appraisal of water quality in Uburu - Okposi Area of Ebonyi State, Southeastern Nigeria. Water Resources – J. Nige. Assoc. of Hydrogeol., 13: 33-39

[4] Amadi, A. N. (2009). Physio-chemical and Bacteriological Evaluation of Groundwater in parts of Aba, Abia State, Southeastern Nigeria. International Journal of Applied Biological Research, Vol. 1, No. 1, pp 63-71.

[5] Amadi, A. N. 2007. Aquifer characterization and groundwater vulnerability around Owerri, Southeastern, Nigeria: Unpublished M. Tech. Thesis, Federal University of Technology, Minna, Nigeria

[6] Alagbe SA (2006). Preliminary evaluation of hydrochemistry of Kalambaina Formation, Sokoto Basin, Nigeria. Environ. Geol., 51: 39 – 45

[7] Ahiarakwem CA, Ejimadu OG (2002). Geochemical properties of groundwater in Orlu Area of Imo State, Southeast Nigeria. Water Resources – J. Niger. Assoc. of Hydrogeology. 13: 19-22

[8] Aniya FMU, Schoenekeck K (1992). Hydrogeological. Investigations of aquifers of Auchi Area J. Min and Geol. 26 (1): 45 – 53.

[9] Domenico PA (1992). Concepts and Models in Ground water Hydrology. McGraw – Hill Book Company, New York.

[10] Domenico PA, Schwartz FW (1988). Physical and Chemical Hydrology. John Wiley and sons, New York.

[11] Decker, J.C. (1981). Potential health hazards of toxic residues in sludge. In sludge-health risk of land application. Ann. Arbon. Sci. Publ. Inc., pp, 85-102

[12] Downey JS (1984). Geology and hydrology of the Madison Limestone and associated rocks in parts of Montona, Nebraska, North Dakota, South Dakota and Wyoming. US Geology Survey Professional Paper 1273 – G.

[13] Etu-Efeotor, J. O. and Akpokodje, G. E., (1990). Aquifer systems of the Niger Delta. Jour. of Mining and Geol., Vol.20, No.2, pp 264-266.

[14] Ehirim, C.N., Ofor, W. (2011). Assessing Aquifer vulnerability solid wastes landfill Sites in a Coastal Environment, Port Harcourt, Nigeria. Trends in Applied Sciences Research, 6(2), 165 –173.

[15] El-Deeb, M.K.Z., Emara, H.I. (2005). Polycyclic aromatic hydrocarbons and aromatic plasticizer materials in the seawater of Alexandria Coastal area. Egyptian J. of Aquat. Res., 31, 15-24.

[16] Horsfall, M., Spiff, A.I. (1998). Principles of environmental Chemistry. Metrol Prints Ltd,Nigeria, pp. 107–118.

[17] Horspers J (1965). Gravity field and structure of the Niger Delta, Nigeria. GSA Bull., 76: 407 – 422.

[18] Martens, D.A., Frankenberger, Jr.T. (1995). Enhanced Degradation of Polycyclic Aromatic Hydrocarbons in soil treated with an Advanced Oxidative Process—Fenton's Reagent. Journal of Soil Contamination, 4(2), 175-190

[19] Nwankwoala, H. O. and Mmom, P. C., (2007). Towards sustainable management of Groundwater in Port-Harcourt Metropolis. Jour. Of Nigerian Environmental Society, Vol. 3, No. 3, pp 204-214.

[20] Nwankwoala, H. O., (2005). Estimating aquifer parameters in parts of Port-Harcourt and environs using pumping test data. Unpublished M.sc thesis, Rivers State University of Science and Technology, Nigeria

[21] Idowu OA, Ajayi O, Martins O (1999). Occurrence of groundwater in parts of Dahomey Basin, Southwestern Nigeria. J. Min. and Geol., 35 (2): 229-236.

[22] Odukoya, O.O., Arowolo, T.A., Bamgbose, O. (2002). Effect of Solid Waste. Landfill on underground and surface water quality at Ring Road, Ibadan. Global J. Environ. Sci., 2(2), 235–242.

[23] Ogbuagu, D.H., Okoli, C.G., Gilbert, C.L., Madu, S. (2011). Determination of the contamination of groundwater sources in Okrika Mainland with Polynuclear Aromatic Hydrocarbons (PAHs). British Journal of Environment & Climate Change, 1(3), 90-102

[24] O.C. Okeke, S.O. Onyekuru*, G. Uduehi and H. O. Israel Geology and hydrogeology of Northern Ishan district, Edo state, Southwestern Nigeria International Research Journal of Geology and Mining (IRJGM) Vol. 1 (1) pp. 001-011

[25] Whiteman, A., 1982. Nigeria: its Petroleum Geology, Resources and Potential. London: Graham and Trotman Publishers, pp301-310

[26] Schwartz FW, Hang ZH (2003). Foundamentals of Groundwater. John Wiley and ons, New York

[27] Teme, S. C., (2002). Geotechnical Consideration on Foundation Design in the Niger Delta. Lead paper presented at the plenary session. Proc. 38th Annual Inter. Conference of the Nigerian Mining and Geosciences Society (NMGS) held in Port-Harcourt.