International Invention of Scientific Journal
ISSN: 2457-0958

Available Online at http://iisj.in/index.php/iisj April, 2018|Volume 02|Issue 04|

Predicting Heterogeneous Structure of Fine Sand on Shigellae Transport Inhibited by Carbon in Coastal Environment

*[1]Ezeilo F.E. and [2]Eluozo S.N.

[1]Department of Civil Engineering, Rivers State University Port-Harcourt, River State, Nigeria
[2]Department of Civil Engineering, Gregory University Uturu (GUU) Uturu, Abia State of Nigeria

***Correspondence Author:** *fabebele@yahoo.com*

Accepted 2018-04-16, Published 2018-04-026

Abstract:

This study monitors the heterogeneous effect on the migration of shigellae influenced by carbon in coastal environment. The study expresses the rate of exponential process of shigellae concentration through the influential that parameter was thorough monitored in the system. The study observed that carbon was not able to inhibit the migration of shigellae. Instead, it increased the population of shigellae in the study area. Results show an increase in the concentration of shigella from 6.93E-05 to 6.95E-04, at depths varying from 3m - 30m, and an increase of 2.64E-05 to 2.64E-04 at depths 3m to 36m.The level of exponential rate despite the variation of concentration express the behaviour of the contaminant in terms of transport to phreatic depositions. This implies that such micronutrient in some deposited litho structures cannot influence the degradation of shigellae concentration in deltaic formations. These were observed from the derived simulation values as the parameter experienced variation, but in linear phase to the optimum rate. These results were subjected to validation with experimental results, and both parameters expressed favourable fits. The structure of fine sand in heterogeneous condition including formation characteristics were found in the study to play serious role on the rate of concentration. The study is imperative because it has expressed their rate of variation and showed insignificant inhibition from carbon.

Key Words: predictive, Heterogeneous, fine sand, and shigellae transport

Introduction:

It has been observed that since 1995 about 2.3 billion people.i.e. (41% of the world's population will definitely experience water stresse. Moreso studies has stated that there will be rapid increase to 3.5billion by 2025 (48% of the expected world population) [1]. This calls for quick measures in the implementation of other ways to maintain water portability [2]. They are utilized for other purpose such as waste water that consists of house hold waste water, industrial waste water and storm water which eventually percolates into groundwater [11, 14]. Most developed nations treat wastewater. In some cities wastewater is used to irrigate multiplicity of crops and landscapes across the globe [5, 6, and 7]. However, efforts were made and most likely the best notable example is in 2001, when 20 million hectares of land were irrigated with waste water partially diluted or undiluted [8, 9, 10]. There have been several outstanding reviews from other researchers on different aspects of waste water irrigation, including health impacts and risks [12, 13, and 14], the ecological fate of organics [9, 10, and 11, 14], management of salts [8, 10, and 13] and public perceptions [3, 4, 7, and 8]. Inventories of waste water use in particular regions have been conducted [11, 12,13], but a broad overview of how many commonly found organic by-products in treated wastewater could affect agricultural productivity with persistent use in irrigation is lacking [13].

Governing Equation and Derived Solution:

$$\frac{dc}{dy} + A_{(y)}C_{(d)} = B_{(y)}C_d{}^n ; n \geq 2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where $A_{(y)}$ and $B_{(y)}$ are function of y

$$\frac{dc}{dy}+A_{(y)}C_{(d)}=B_{(y)}C_d^{\ n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2a)$$

Divided by (1) through by C_d^{-n} we have obtain

$$C_d^{\ -n}\frac{dc}{dy}+A_{(y)}C_d^{\ 1-n}=B_{(y)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2b)$$

Let β = $C_d^{\ 1-n}$

$$\frac{d\beta}{dy}=(1-n)C_d^{\ -n}\frac{dc}{dy}$$

This implies that;

$$C_d^{\ -n}\frac{dc}{dy}=\frac{1}{1-n}\frac{d\beta}{dy}$$

Multiplying Equation (2a) through by (1- n)

$$(1-n)C_d^{\ 1-n}\frac{dc}{dy}+(1-n)A_{(y)}C_d^{\ 1-n}=(1-n)B_{(y)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

If recall that, β = $C_d^{\ 1-n};\frac{d\beta}{dy}=(1-n)C_d^{\ -n}\frac{dc}{dy}$

Therefore equation (3) can be written as:

$$\frac{d\beta}{dy}+(1-n)A(y)\beta=(1-n)B(y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

If we say A=B/2

$$\frac{d\beta}{dy}+(1-n)\tfrac{B}{2}(y)\beta=(1-n)B(y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$\frac{2d\beta}{dy}+(1-n)B(y)\beta=2(1-n)B(y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$\frac{2d\beta}{dy}+\beta(1-n)B(y)=2(1-n)B(y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$\frac{2d\beta}{dy}=(1-n)B(y)[2-\beta] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$\frac{2d\beta}{2-\beta}=(1-n)B(y)dy \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

$$\frac{2}{2-\beta}\frac{d\beta}{dy}=(1-n)B(y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Let $\frac{2}{2-\beta} = \phi^2$

$$\phi^2 \frac{d\beta}{dy} = (1-n)B(y) \qquad (11)$$

$$\frac{d\beta}{dy} = \left(\frac{(1-n)B(y)}{\phi^2}\right) \qquad (12)$$

$$d\beta = \frac{(1-n)B(y)dy}{\phi^2} \qquad (13)$$

$$\beta = \int \frac{(1-n)B(y)dy}{\phi^2} \qquad (14)$$

$$\left[\beta = \frac{1}{\phi^2}\int (1-n)B(y)dy\right] \qquad (15)$$

$$\beta = \frac{1}{\phi^2}\int (1-n)B(y)dy \qquad (16)$$

$$\beta = \frac{1}{\phi^2}\int (1-n)B(y)dy = \frac{1}{\phi^2}(1-n)B(y)Y + K_1 \qquad (17)$$

$$\left[\beta = \frac{(1-n)}{\phi^2}B(y)Y\right] \qquad (18)$$

Materials and method:

Standard laboratory experiment was performed to monitor the rate of Shigellae transport at different formation. The soil deposition of the strata was collected in sequences based on the structural deposition at different study areas. The samples collected at different locations generated variation of Shigellae concentration at different depths through its pressure flow at the lower end of the column. The experimental result was applied and compared with theoretical values for model validation.

Results and Discussion:

Results and discussion are presented in tables including graphical representation of heterogeneous permeability coefficient at different depths.

Table 1: Predictive and Experimental Values for Shigellae Concentration at Different Depths

Depth [M]	Predictive Concentration [Mg/L]	Experimental Concentration [Mg/L]
3	6.93E-05	6.04E-05
6	1.38E-04	1.20E-04
9	2.10E-04	1.80E-04
12	2.77E-04	2.40E-04
15	3.47E-04	3.40E-04
18	4.16E-04	3.60E-04
21	4.85E-04	4.20E-04
24	5.54E-04	4.80E-04
27	6.24E-04	5.40E-04
30	6.93E-04	6.00E-04

Table 2: Predictive and Experimental Values for Shigellae Concentration at Different Depths

Depth [M]	Predictive Concentration [Mg/L]	Experimental Concentration [Mg/L]
3	2.64E-05	2.70E-05
6	5.28E-05	5.40E-05
9	7.92E-05	8.10E-05
12	1.06E-04	1.08E-04
15	1.32E-04	1.35E-04
18	1.58E-04	1.62E-04
21	1.84E-04	1.89E-04
24	2.11E-04	2.16E-04
27	2.38E-04	2.43E-04
30	2.64E-04	2.70E-04

Table 3: Predictive and Experimental Values for shigellae Concentration at Different Depths

Depth [M]	Predictive Concentration [Mg/L]	Experimental Concentration [Mg/L]
3	9.10E-06	9.2E--06
6	1.81E-05	1.82E--05
9	2.72E-05	2.72E-05
12	3.62E-05	3.62E-05
15	4.53E-05	4.52E-05
18	5.44E-05	5.44E-05
21	6.34E-05	6.32E-05
24	7.24E-05	7.22E-05
27	8.15E-05	8.12E-05
30	9.10E-05	9.02E-05
33	9.97E-05	9.92E-05
36	1.10E-04	1.08E-04

Table 4: Predictive and Experimental Values for Shigellae Concentration at Different Depths

Depth [M]	Predictive Concentration [Mg/L]	Experimental Concentration [Mg/L]
3	3.17E-08	3.04E-08
6	6.35E-08	6.04E-08
9	9.53E-08	9.04E-08
12	1.27E-07	1.20E-07
15	1.59E-07	1.50E-07
18	1.96E-07	1.80E-07
21	2.22E-07	2.10E-07
24	2.54E-07	2.40E-07
27	2.85E-07	2.70E-07
30	3.18E-07	3.00E-07

Table 5: Predictive and Experimental Values for Shigellae Concentration at Different Depths

Depth [M]	Predictive Concentration [Mg/L]	Experimental Concentration [Mg/L]
3	5.46E-07	6.20E-07
6	1.16E-06	1.22E-06
9	1.64E-06	1.82E-06
12	2.18E-06	2.42E-06
15	2.73E-06	3.02E-06
18	3.27E-06	3.62E-06
21	3.82E-06	4.22E-06
24	4.37E-06	4.82E-06
27	4.91E-06	5.42E-06
30	5.46E-06	6.02E-06

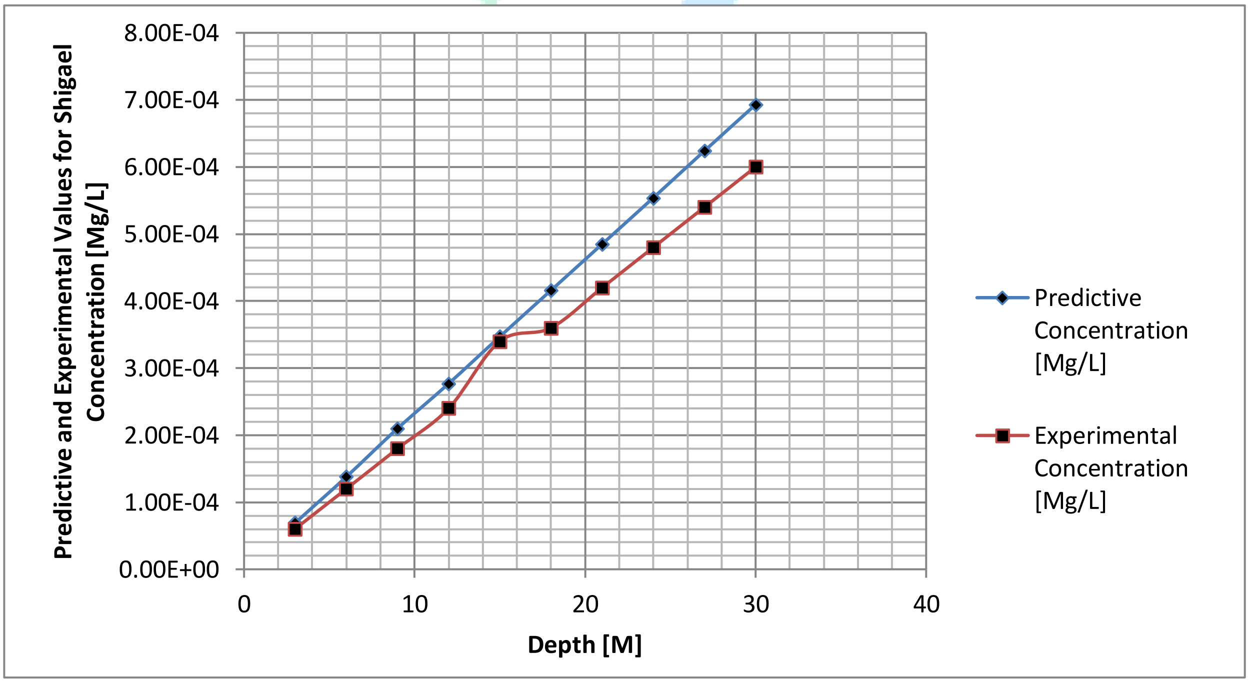

Figure 1: Predictive and Experimental Values for Shigellae Concentration at Different Depths

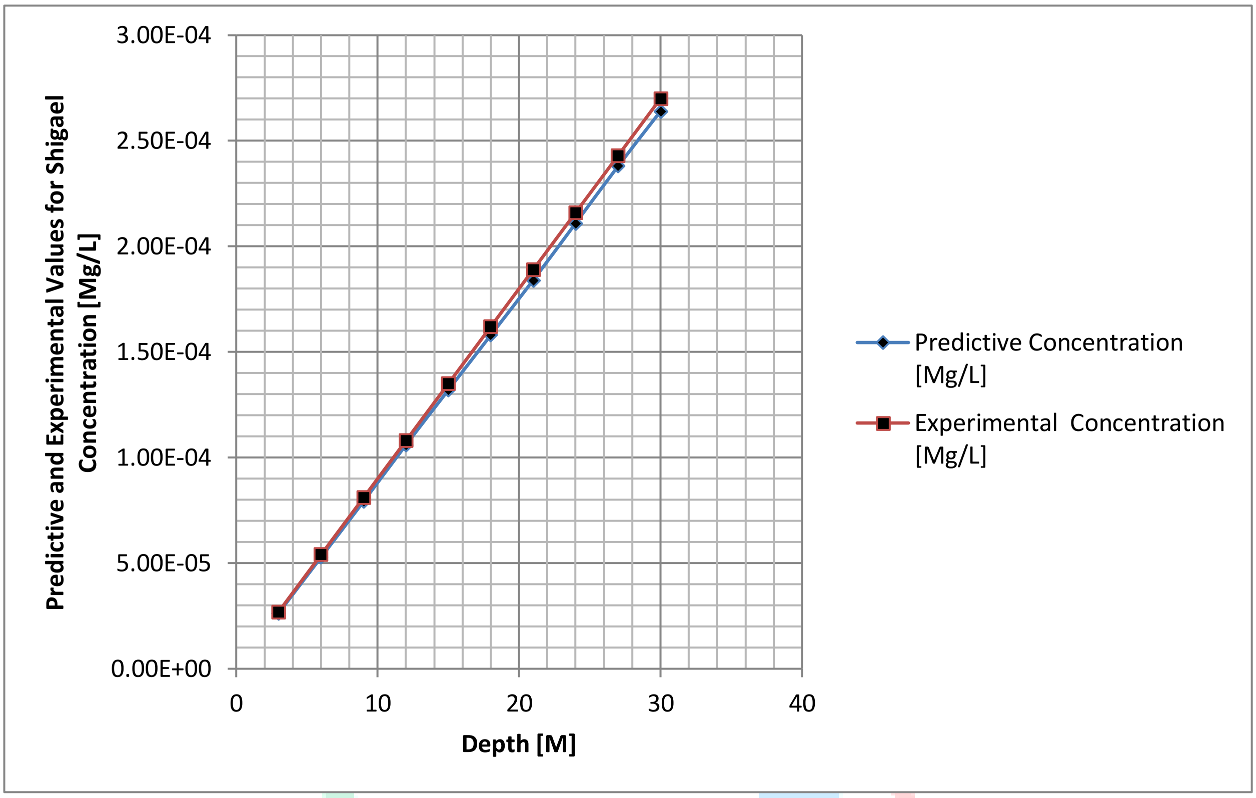

Figure 2: Predictive and Experimental Values for Shigellae Concentration at Different Depths

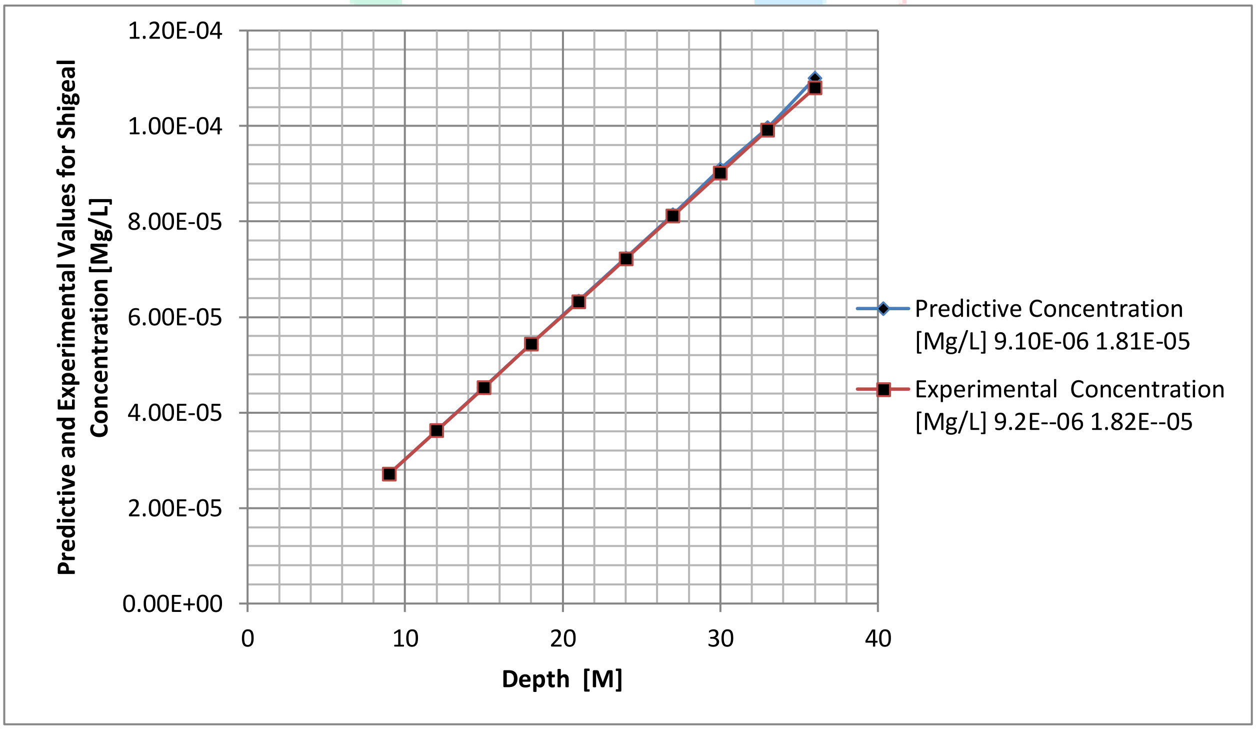

Figure 3: Predictive and Experimental Values for shigellae Concentration at Different Depths

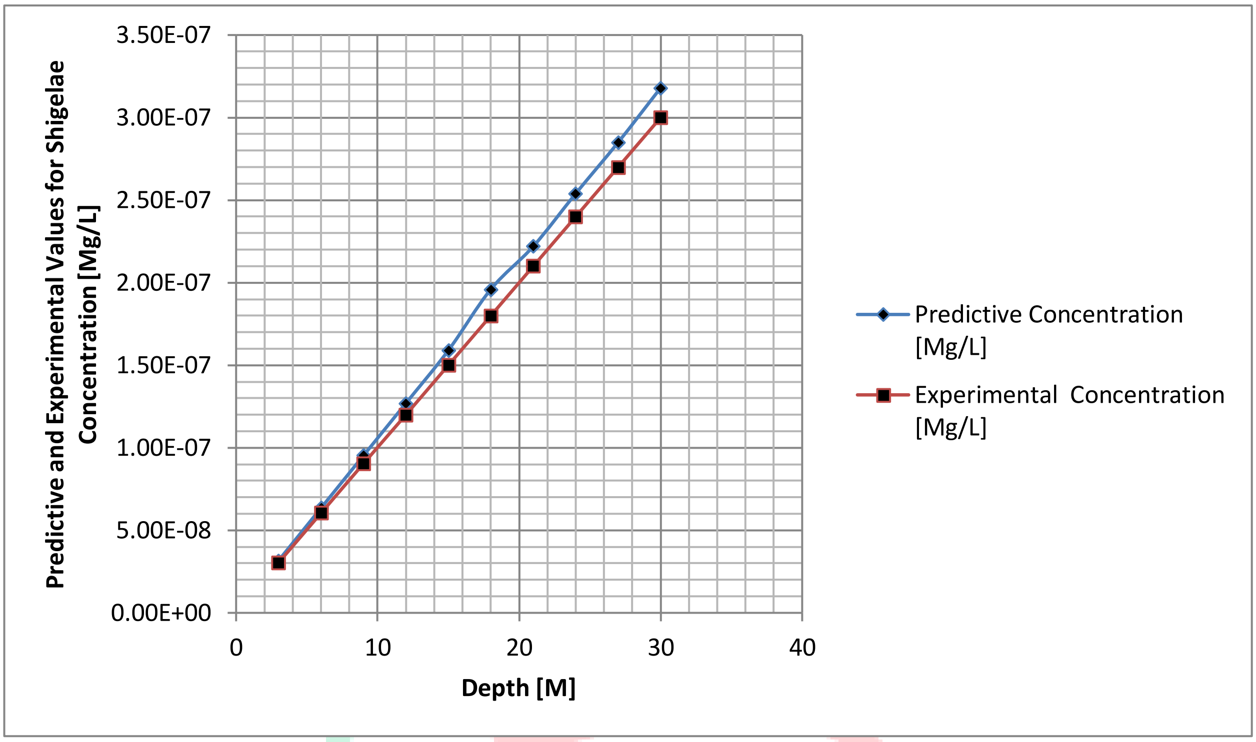

Figure 4: Predictive and Experimental Values for Shigellae Concentration at Different Depths

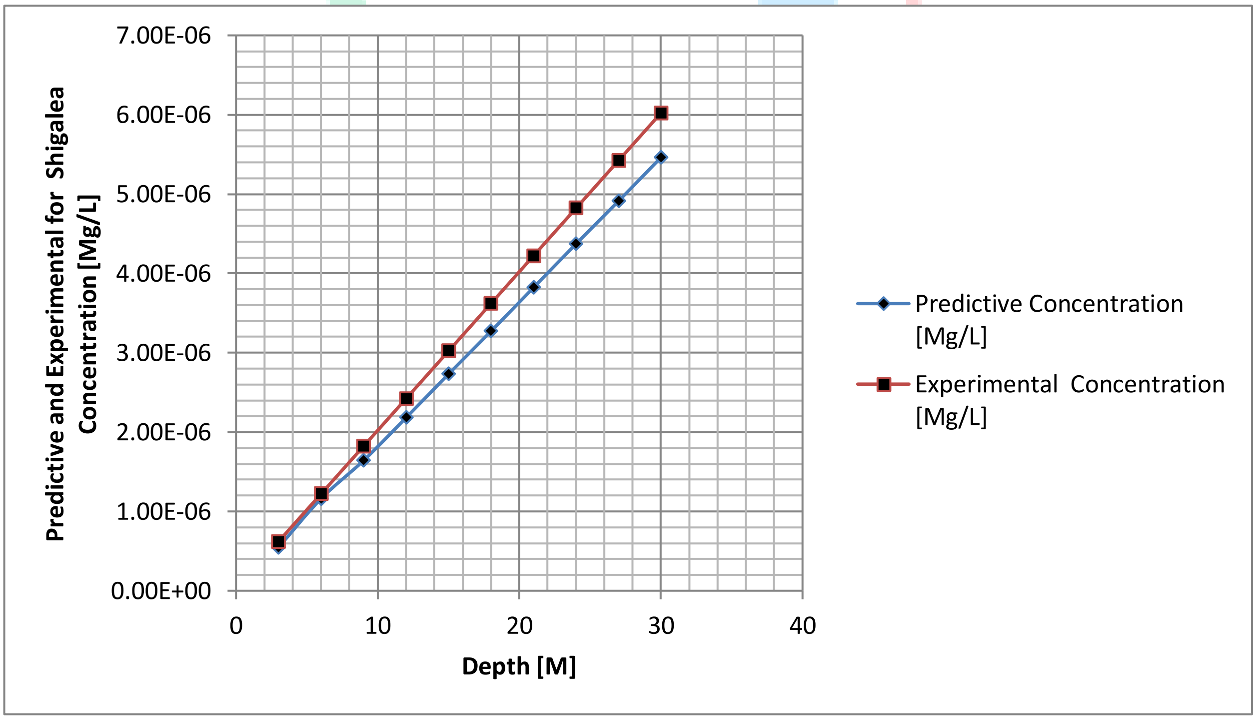

Figure 5: Predictive and Experimental Values for Shigellae Concentration at Different Depths

Figures one to five presented shows the rates at which exponential migration of shigellae were observed in the transports process. Furthermore, it explained linear migration of the contaminant based on the heterogeneity of the strata in the coastal environment. These graphical representations express various rates of concentration under the influence of carbon in the study location. Generally, the migration rate monitored were observed to predominantly transport in linear condition. The influential transport of the system in most of these figures are the heterogeneous structure of fine sand, but the predominant deposition of carbon was observed to increase the microbial population. Variation of concentrations observed from the figures explained other influences from other conditions that may affect the behaviour of the transport process developing exponential phase of the system. The deposition of carbon as micronutrients including heterogeneous setting pressured all the rates of concentrate are expressed in the figures above. The simulation values were subjected to validation by comparing it with experimental values, and both parameters developed faviourable fits. The heterogeneous structure of fine sand was observed not to influence the reduction of shigellae transport in the coastal environment, rather it allowed it to migrate faster as experienced in the transport process.

Conclusion:

The study was carried out to monitor the rate of inhibition from carbon in various litho structures in the study environment. However, from the results generated from the simulation values, the study observed that carbon was not able to inhibit the migration of shigellae. Instead it increased the population of shigellae in the study area. The level of exponential rate despite the variation of concentration express the behaviour of the contaminant in terms of transport to phreatic depositions. This implies that such micronutrient in some deposited litho structures cannot influence the degradation of shigellae concentration in deltaic formations. There is no doubt that this study has revealed that carbon failure has inhibited the migration of shigellae in the study environment. The developed model was able to monitor the migration rate at various lithostratification, as observed by the stated findings through graphical representation. Experimental values were applied and compared with predictive values for model validation, and both parameters developed faviourable fits.

References:

1) World Resources Institute (2000). Projected annual renewable water supply perpers on by river basin, 2025. Available at earth trends. wri.orgmaps_ spatial/ maps_detail_static.php?map_select=265&theme=4(verified7January2010).
2) Anderson J (2003). The environmental benefits of water recycling and reuse. Water Supply3: 1-10.
3) Blumenthal U J. Peasey A (2002). Critical review of epidemiological evidence of the earth effects of waste water and excreta use in agriculture. London School of Hygiene and Tropical Medicine, London
4) Toze S (2006). Reuse of effluent water-benefits and risks. Agric. Water Manage. 80: 147-159
5) Müller K, Magesan G N, Bolan N. S (2007). A critical review of the influence of effluent irrigation on the fate of pesticides in soil. Agric. Ecosyst. Environ. 120: 93-116.
6) Rengasamy P (2006). Soil salinity and sodicity. pp. 125-138.In Stevens (ed.) Growing crops with reclaimed wastewater.CSIRO Publ. Colling wood, Australia.
7) Hartley TW (2003). Water reuse: Understanding public perception and participation. Water Environ. Res. Found. Alexandria, VA. pp. 115-126.
8) PoM, Nancarrow B. E (2004). Consumer perceptions of the use of reclaimed water for horticultural irrigation. Aust. Res.Ctr. for Waterin Society, CSIRO, Perth, Australia.
9) Angelakis A Thairs T, Lazarova V. (2001). Water reuse in EU countries: Necessity of establishing EU guidelines. Rep. EU2-01-26. EUREAU Water Reuse Group, Brussels.
10) Bixio D, De Hyer B, Cikurel H, Muston M, Miska V, Joksimovic, Schäfer AI, Ravazzini A, Aharoni A, Savic D,Thoeye C (2005). Municipal wastewater reclamation: Where dowestand? Anoverview of treatment technology anmanagement practice. Water Supply, 5: 77-85.
11) Saqer A-S (1996). Environmental considerations for wastewater reuse in agriculture. Water Sci. Technol. 33 (10-11): 345-353.
12) Radcliffe J C (2004). Water recycling in Australia. Aust.Acad. Technol. Sci. Eng. Parkville, Australia. 6: 823-840.
13) Babatunde C. Akande, Patrick A. 2010; Ndakidemi, Olalekan Fatoki and James Odenda al 2010 The possible effect of the bioaccumulation of disinfectant by products on crops irrigated with treated wastewater African Journal of Biotechnology Vol. 9(9), pp. 1280-1287, 1 March 2010.
14) Eluozo S. N Oba. K. M 2017; Predicting Achromobacter Transport Pressured by Deposition of Carbon in Heterogeneous Sand Gravel Formation, Trans-Amadi Industrial Layout, Port Harcourt. International Journal of Biochemistry, Biophysics & Molecular Biology. Vol. 2, No. 5, 2017, pp. 51-60.
15) Eluozo S.N. and. Ezeilo F. E Modeling of E. coli Transport on Homogeneous Clay Formation Influenced by Permeability in Ahoada East, Rivers State of Nigeria; International Journal of Civil Engineering and Technology Volume 7, issue 1, Jan-Feb 2016, pp315-323
16) Eluozo S.N. and. Ezeilo F. E Development of Mathematical Model to Predict the Transport of E. coli in a Natural Pond International Journal of Civil Engineering and Technology Volume 7, issue 1, Jan-Feb 2016, pp324-336.

17) Ezeilo F.E, Eluozo S.N. Modeling and Simulation of Partial Deposition of Ionic Content in Silty Clay at Igwuruta Area of Rivers State Engineering Sciences 2017;2(2): 37-44.

18) Ezeilo F.E, Eluozo S.N. Predicting Campylobacter Transport Influenced by Permeability and Void Ratio in Partial Heterogeneous Sand Gravel Formation, Sapelle; Delta State of Nigeria. Engineering Sciences 2017;2(2): 30-36