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Original article

Establishments of porosity model and evaluation to monitor the effect on c to ground water aquifers in port harcourt

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ABSTRACT

Model establishment and calibration of porosity to monitor the effect of shigella migration to groundwater aquifer has been examined. These calibrations were to establish the model that will determine the influence of porosity at various depths on the migration influence of shigella in the study areas. Standard laboratory experiment was done to determine their various degree of porosity.The figures presented established the highest degree at 5 metres in Lateratic soil. Such result implies that the rate of porosity on fine and coarse formation will definitely increase the porosity rate more than what is deposited at 5 metres. The study from this dimension was able to establish a relationship between the porosity and the solute on the flow rate level on the soil, this were done through the definition of various variables and there roles in the transport of shigella on soil and water, the fluid pass through the pore space between the intercedes of the soil, so both parameters definitely has a relationship, and such relationship influence the transport of shigella in the study area.

1. Introduction

Grain size, shape, and packing are characteristics of granular porous media that have a significant effect on groundwater flow, affecting both porosity and permeability. Hubbert [1940] determined that if uniform spheres are uniformly packed, porosity is not a function of grain diameter but permeability is a function of the square of the grain diameter. However, natural sediment does not consist of uniform grains and packing; it contains mixtures of finer and coarser grains of irregular shapes and complex packing arrangements. Nevertheless, the effects on porosity and permeability when sediment is not uniform in size and packing have been extensively explored but the effects on porosity and permeability when sediment is not uniform in shape needs to be explored further. Laboratory and field experiments have verified that grain size and packing affect porosity and permeability in unconsolidated clastic sediment [Freeze and Cherry, 1979; Marsily, 1986; Domenico and Schwartz, 1990]. Research has also been conducted on estimating hydraulic parameters, porosity and permeability, and the sediment parameters, grain size and packing. Koltermann and Gorelick [1995] worked to improve the knowledge of these relationships by modifying previous petrophysical models to more accurately predict the permeability of sediment mixtures. Kamann [2004] expanded on the work of Koltermann and Gorelick [1995] to account for five possible types of packing rather than the two types of packing upon which their fractional packing model was based. He took porosity and permeability

Measurements on model bimodal sediment mixtures that varied in the volume fraction of finer grains, which he compared with predicted values. In keeping with Koltermann and Gorelick [1995], Kamann [2004] also modeled the porosity and permeability of bimodal sediment mixtures to address the effect of the volume fraction of fines. As the volume fraction of fines increases within a sediment mixture, porosity changes as the packing of the mixture changes. A porosity minimum occurs when the volume of the finer component equals the pore volume of the coarser component. Kamann.s [2004] used spherical grains to model poorly-sorted sands and sandy gravels. Spherical glass beads and marbles were used to represent fine sand, medium sand, coarse sand and pebble grain sizes. Kamann [2004] chose to use spherical grains to eliminate variations in shape. He assumed that the bimodal sediment mixtures of spherical glass beads and marbles provided an approximation of natural sediment. Conrad [2006] focused specifically on measurements taken at small support scales using the air-based method of determining permeability on mixtures of spherical grains. He revised the permeability procedures, improved the air-based permeameter correction model developed by Kamann [2004], replicated and improved upon the permeability measurements taken by Kamann [2004], and further confirmed the applicability of the petrophysical model for permeability. The research conducted by Koltermann and Gorelick [1995], Kamann [2004] and Conrad [2006] explored the effect of grain size and packing on porosity and permeability. The focus of this research will explore the effect of grain size, shape, and packing on porosity and permeability by using bimodal mixtures of natural sediment This study will continue the work of Kamann [2004] and Conrad [2006] by replacing spherical glass beads and marbles with natural sand grains and pebbles to reexamine the effect of the volume fraction of fines on porosity and permeability. The goals of this study are to (1) measure porosity and permeability for mixtures of natural sediment that vary by percentages of the volume fraction of finer grains, (2) to evaluate if the model created by Kamann [2004] based on spherical grains is accurate for natural sediment grains and (3) to improve the confidence of estimating porosity and permeability [Peter 2005].

Soil and groundwater contamination remains a threat to public health and the environment despite decades of research. Numerous remediation technologies including bioremediation, thermal treatment, soil vapor extraction (SVE), zero-valent iron (ZVI), and in situ chemical oxidation (ISCO) have been developed over the past 30 years. Bioremediation is a cost-effective and simple remediation process for the degradation of contaminants such as benzene, toluene, ethylbenzene, and xylenes (BTEX) [Kao et al., 2010; Nebe et al., 2009]. However, bioremediation is constrained by the available microbial community and by its degradation capacity in a given environment [Steliga et al., 2009]. Due to the complexities of extending laboratory results to the field [Stenuit et al., 2008], the actual rate of degradation as a result of bioremediation is slow relative to other treatments and often relies on natural attenuation, where no treatment is applied and the contaminant degrades naturally (Kao et al., 2010). Bioremediation, SVE, and ZVI degrade or constrain a narrow range of contaminants and are generally unable to treat sorbed contaminants and dense nonaqueous phase liquids (DNAPLs) due to mass transfer limitations [Watts and Teel, 2006; Watts, 1998]. Persulfate is typically activated to promote contaminant degradation (Liang et al., 2004; aldemer et al., 2007; Furman et al., 2009). The activating agents include: iron-chelated activation [Liang et al., 2004], base activation [Furman et al., 2009], and organic activation [Ahmad, 2010].

2. Materials and methods

Soil samples from several different borehole locations, were collected at intervals of three metres each (3m). Soil sample were collected in five different location, applying insitu method of sample collection, the soil sample were collect for analysis, standard laboratory analysis were collected to determine the degree of porosity, the result were analysed to determine the influence on shigella transport to ground water aquifers in the study area.

3. Results and discussion

Establishments of porosity model and evaluation to monitor the effect on shigella migration to ground water aquifers establishments of porosity model and evaluation to monitor the effect on shigella migration to ground water aquifers are presented in Tables and Figures Bellow.

Table 1
porosity of soil at various Depths.

Depth MM	Porosity
200	0.18
400	0.15
800	0.13
1000	0.13
1200	0.12
1400	0.12
1600	0.11
1800	0.11
2000	0.11
2500	0.11
3000	0.11
4000	0.1
5000	0.1

Table 2
porosity of soil at various Depths.

Depth MM	Porosity
200	0.19
400	0.18
800	0.12
1000	0.12
1200	0.13
1400	0.12
1600	0.11
1800	0.11
2000	0.11
2500	0.12
3000	0.11
4000	0.11
5000	0.11

Table 3
porosity of soil at various Depths.

Depth MM	Porosity
200	0.17
400	0.14
800	0.13
1000	0.13
1200	0.12
1400	0.12
1600	0.13
1800	0.12
2000	0.11
2500	0.11
3000	0.1
4000	0.1
5000	0.1

Table 4
porosity of soil at various Depths.

Depth MM	Porosity
200	0.24
400	0.2
800	0.18
1000	0.14
1200	0.14
1400	0.13
1600	0.12
1800	0.13
2000	0.12
2500	0.12
3000	0.12
4000	0.11
5000	0.11

Table 5
porosity of soil at various Depths.

Depth MM	Porosity
200	0.22
400	0.18
800	0.17
1000	0.15
1200	0.15
1400	0.14
1600	0.14
1800	0.13
2000	0.13
2500	0.12
3000	0.12
4000	0.12
5000	0.11

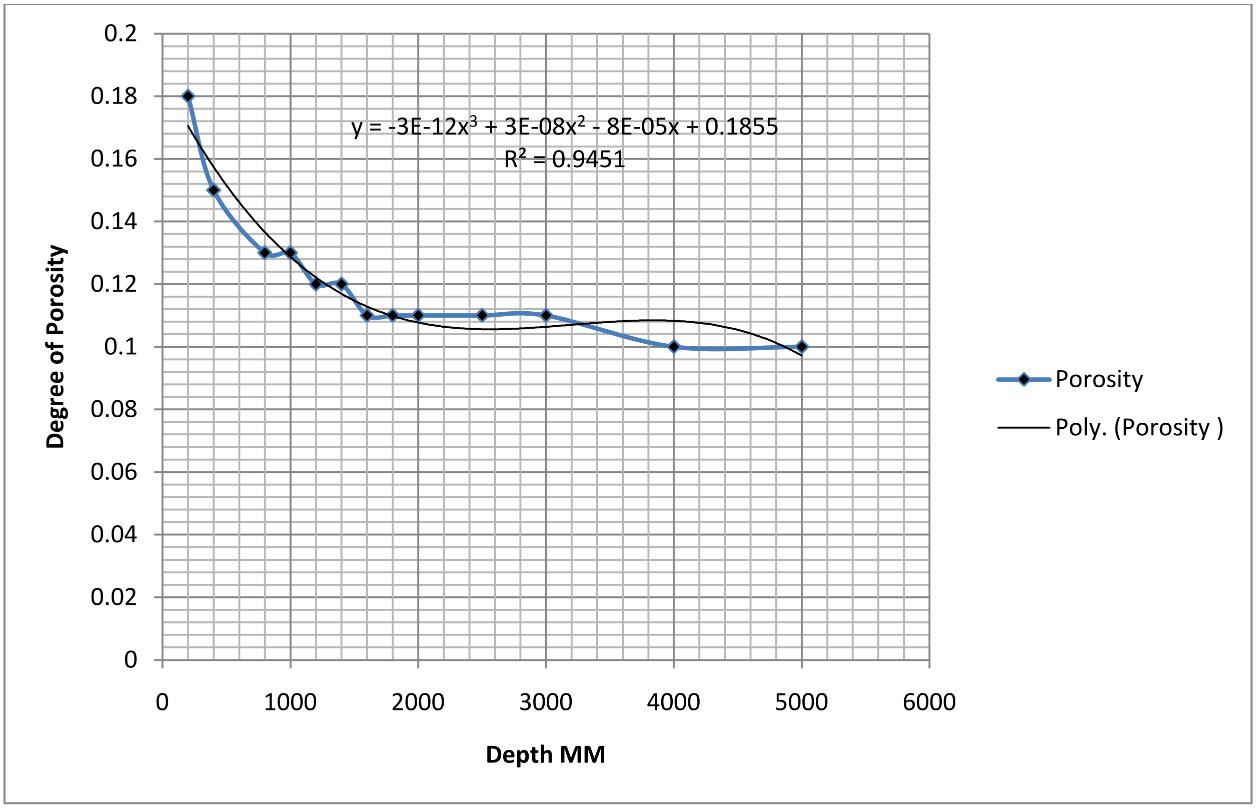

Fig. 1. Porosity of soil at various depths.

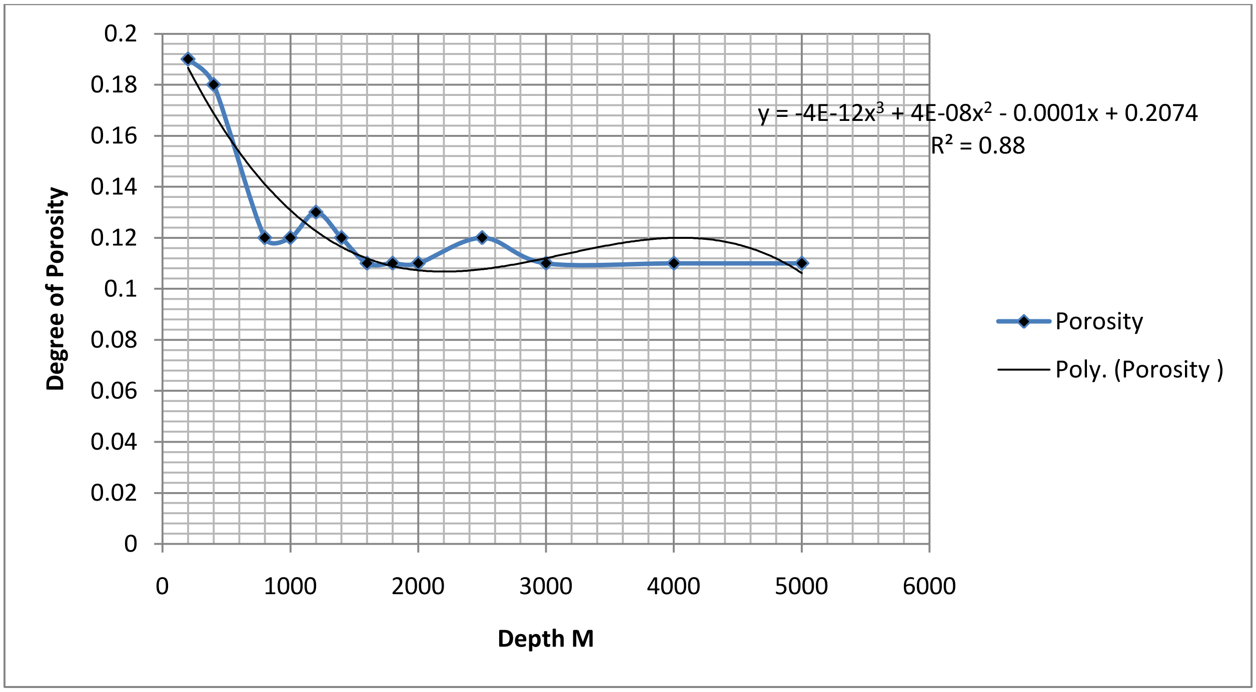

Fig. 2. porosity of soil at various depths.

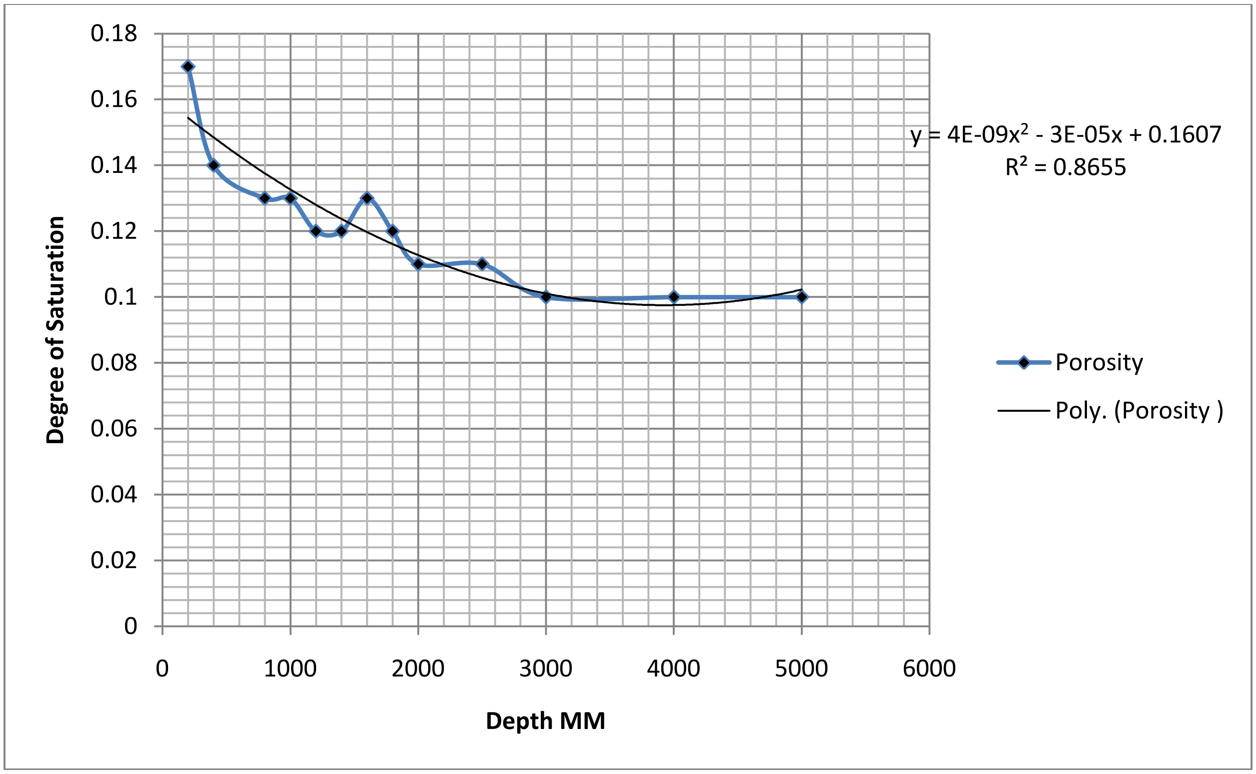

Fig. 3. porosity of soil at various depths.

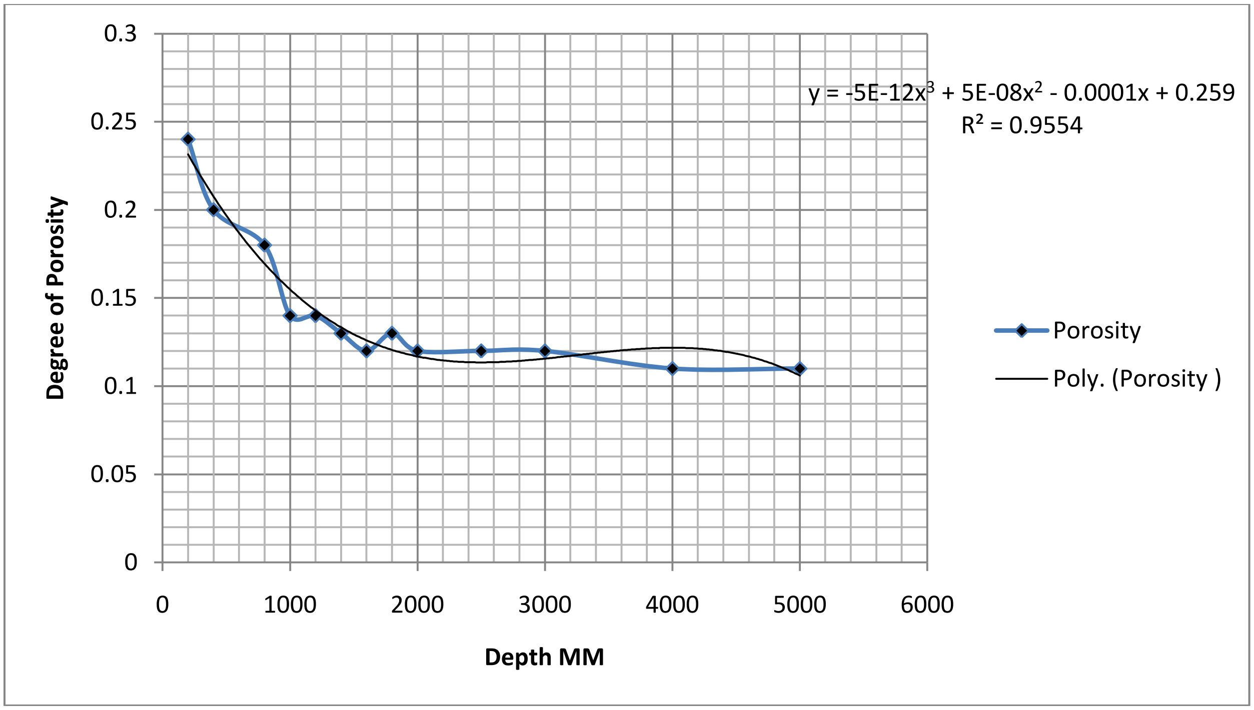

Fig. 4. porosity of soil at various depths.

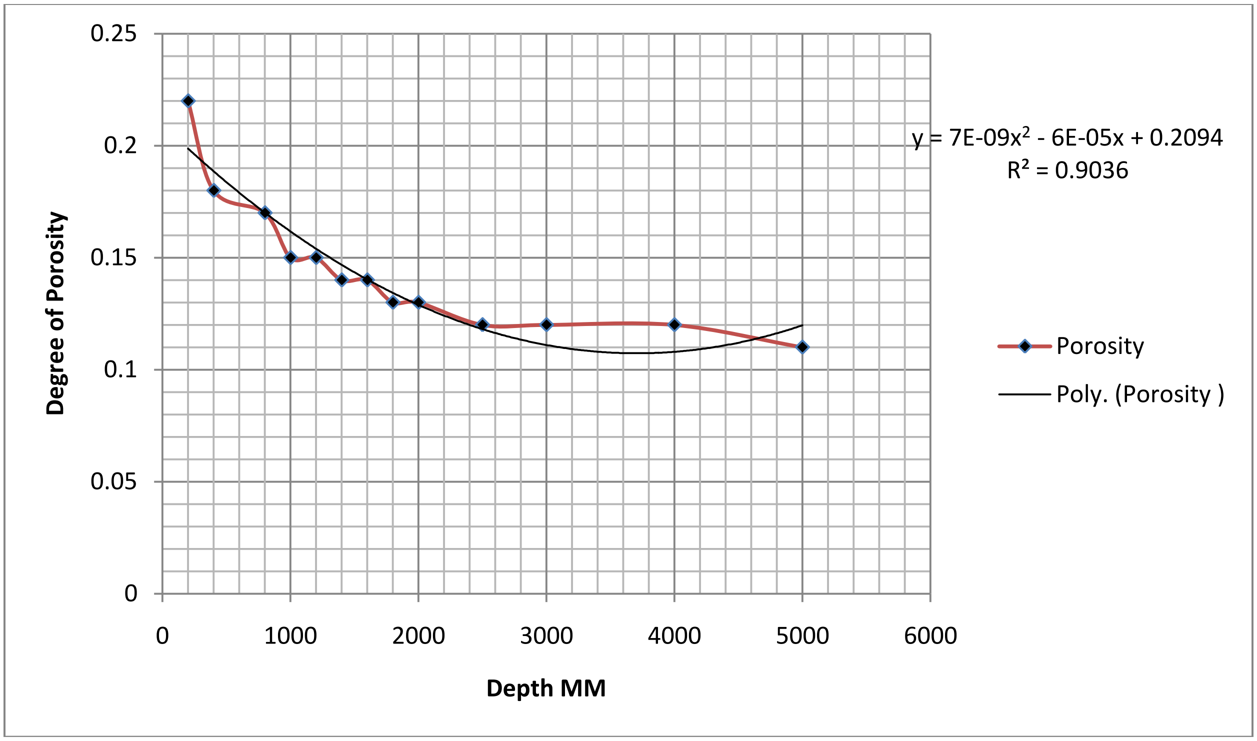

Fig. 5. porosity of soil at various depths.

Figure 1 shows that low level of porosity were experienced at 0.2m, and gradual increase it highest degree of porosity slight fluctuation down the point where the lowest degree of porosity were established at five metres. Figure 2 maintained similar levels like figure 1, gradual increases low degree of porosity were established at 0.2m, and gradual increase of porosity were experienced between 0.4 to 0.8 metres. While fluctuations were observed between 1.2 to 22.5 metres, finally, the porosity observed constant degree between 3 to 5 metres where the highest degrees were recorded. Figure 3 maintained the same deposition of porosity on the soil, the lowest were observed at 3 metres, while it finally maintained constant degree of porosity from 3 to 5 metres. Figure 4 experienced the lowest degree of porosity at 0.2 metres and it gradually experienced fluctuation form between 0.2 metres to 0.4 metres slight were experienced to the point where the highest degree were recorded at 5 metres. Figures 5 observed similar rate of porosity like figure 0.4. The lowest degrees were recorded at 0.2 metre. It finally experienced constant degree of porosity between 2.8 to 5 metres. Water only flows in the pore space, the actual flow velocity (v), also termed the linear velocity as the volumetric flow rate per unit interconnected pore space. The effect porosity is the pore true velocity of water flow, the rate of porosity are determined through the soil stratification, the intercedes of the soil structural deposition and the degree of porosity where found to increase very high at 5 metres, this condition implies that contaminant with fluid flowing through the pore space of soil formation will definitely experience high concentration shigella in groundwater aquifer. The experimental assessment were done between 0 to 5 metres at lateritic soil, and the degree of porosity experienced this high rate, in such condition it implies that at homogenous fine and coarse formation it will definitely increase its porosity more higher than the result of lateritic soil at 5 metres. Such formation characteristics are imperative to investigate the rate of porosity influence on shigella microbial migration, because the activities of man will definitely develop regeneration of the microbial species in the study location. Therefore, the rates of the microbial influence on porosity at different depths were necessary to determine their various degrees in the study location.

4. Conclusion

An aquifer perform two important functions – a storage function and conduct function the intensities of a water bearing formation, it also act as storage site and are part of a network of conduits. Groundwater is constantly moving through these conduits under the local hydraulic gradient rate of movement that vary from feet per year to feet per day. Such condition is a serious baseline to understand on groundwater movement. The major influence of the flow of these fluid are the rate of porosity, this is determined through the stratification of the soil formation, the transport of solute pass through this flow path in the soil contaminant groundwater aquifers. Such condition is imperative to monitor their various source of pollution, the establishment of porosity model and its assessment will calibrate the rate of porosity and determine the rate of solute contaminant of shigella migration to groundwater aquifer. The figures present express the rate of increase of porosity at different locations and depths, it was confirmed that the highest degree of porosity are deposited at 5 metres, the depth that established the highest degree were confirmed to be at lateritic soil, this condition implies at silty fine and coarse sand formation that is predominant will experience more porosity, the porosity influence were confirmed through , the increase of degree of porosity and concentration of the solute, based on the deltaic nature of the soil including the reflection of the climatic condition.

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