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Research article

MATHEMATICAL MODEL TO MONITOR POROSITY AND PERMEABILITY INFLUENCE ON ENTERIC VIRUS TRANSPORT ON RETARDATION PHASE IN FINE AND SILTY FORMATION IN UDI, BAYELSA STATE

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Abstract

permeability of flow are deposited in soil under the influence of high degree of porosity in the soil, enteric virus the structural strata deposition were found to several varieties of influences on retardation phase including its deposition, the concentration were thoroughly observed through standard investigation analysis in the study location, the rate of concentration of enteric virus were found to observed retardation, numerous influence in the strata can be responsible for retardation of enteric virus in the system, but the focus of the study was to monitor several concentrate at different stratum influenced by permeability and porosity of transport, such formation characteristics were found essential to monitor the system due to the geological setting of the formation, climatic influences were also found to pressure of the study area through high rain intensities, these conditions are found to develop high degrees of soil permeability and porosity in the study location, therefore the rate of the two stated parameters played major role on the transport of enteric virus in the study area, development of mathematical modeling approach were found imperative to determined detailed function observed in the migration process of the microbes, population increase were considered in the derived solution were the increase of enteric virus concentration played major roles in the system, the derived model will definitely express the roles both influential parameters has enteric virus deposition in the study location.

Keywords: Mathematical mode, porosity and permeability, enteric virus retardation phase and silty formation

1. Introduction

The regional geology has been mapped and described by Wells and O'Brien (1994a and 1994b bread 2005 Eluozo and, Nwaoburu 2013) and is also summarized by Whitaker and Green (1978). Early work on the volcanic rocks wasp documented by Stevens (1968), and more detailed geologic information and mapping in the study area provided by Willey (1992). The regional geomorphology was interpreted by Ollier and Harworth (1994). The area is dominated by two main rock units: a near-horizontal to gently dipping Middle Jurassic sedimentary sequence of the Moreton-Clarence Basin, part of the Great Artesian Basin, and the mid-Tertiary Main Range Volcanics (MRV), extending up to 50 km westward from Toowoomba. These strata unconformable overlie a concealed basement of Palaeozoic rocks, the New England Orogen (**I**brahim,2006, Bread, 2005, Bread, et al, 2005, Briggs, 2008).The primary environmental issue facing the whole world, in terms of subsurface environment, is the protection of good quality groundwater and the clean-up or remediation of already contaminated groundwater resources (**I**brahim,2006).. Before 1976, US citizens had used open dumping of wastes which invariably resulted into soil contamination, groundwater pollution, and adverse health hazards, including cancer in children traceable to contamination by industrial chemicals. This led to public outcry and environmental regulations promulgated by both federal and state governments. In a developing country like Nigeria where the practice of waste containment is nonexistent, deadly health hazards from soil or groundwater pollution by harmful elements like mercury (Hg), potassium (K), sodium (Na), zinc (Zn), lead (Pb), etc are a reality especially when the country steps into proper development of her natural mineral resources To impede the transport processes of these contaminants, compacted clay liners are normally used as an integral component of the lining systems to cover landfills, municipal and hazardous waste impoundments, and also to cap new or old waste disposal units (Daniel and Benson, 1990; Albrecht and Benson, 2001 Shackelford, 1994, 2000). Considering advection as a major transport process, the most significant factor affecting the performance of compacted clays is hydraulic conductivity. Apart from hydraulic conductivity, diffusion is a very important transport mechanism especially if the seepage velocity is or approaches zero (Shackelford and Daniel, 1991, Shackelford, 1990, 1993). Contaminants travel along the pathway of least resistance, and narrow permeable channels usually govern their movement. Defining these transport pathways is of paramount importance, and is difficult using traditional methods of drilling and sampling because the volume explored is small, sampling is slow, and the cost of sampling is often prohibitive.

2. Theoretical background

The deposition of porosity in and permeability of deposition of enteric virus in retardation phase in fine and silty sand has been expressed in this dimension, prior to this study, it was found essential because it will instituted thorough relationship between permeability of flow and porosity in homogeneous setting through the transport system. The development of high degree of permeability, there a tendency of fluid flow base on the deposition of formation in the study area, similar condition are appropriate to fluid flow dynamic of transport in soil and water environment. The rate of Entric virus transport in soil has been established on several transport condition under the influences of enteric virus system. The movement of the microbes at this state are under plug flow condition has recorded different concentration with respect to time in soil and water environments. The notion is to observe the rate of permeability influence and its relationship in diverse scope. The principal equations were built up to establish a permeability relationship with porosity of transport in different stratifications of the formation. The principal equation will be derived with applicable mathematical approach to set up a model that will observe permeability and porosity of transport influence on enteric virus deposition in the study area. More so however, numerous information on survival of the microbes in saturated zone is particularly imperative in areas with shallow aquifers or in situations where possibly will be polluted in surface water may come in direct contact with the aquifer. Also, areas with high annual or seasonal rainfall may experience situations where more rapid transport of surface organisms to aquifers occurs due to greater adjectives flow of water. The study area and other part of the world that deposit similar geological and climatic conditions in such region with high seasonal precipitation, limited vertical topography, and therefore in many places shallow water tables/small vadose zones. The karts geology of the Florida peninsula is also a contributor to more rapid transport of surface water to aquifers than most other areas of the continental U.S. Most studies on survival of public-health-related microorganisms in ground water have considered inactivation of viruses, as these organisms are often considered the most readily transported through the subsurface and most threatening to ground water supplies. But, given the karst geology of Florida, with associated solution channels and sometimes relatively high bulk porosity, larger organisms such as bacteria and intestinal parasite cysts and oocysts are of equal concern. Thus, it is important to examine the fate or survival of all groups of microorganisms in ground water, in the bulk liquid phase of the ground water environment.

3. Governing Equation

$$R\frac{\partial C}{\partial t} = D\phi\frac{\partial^2 C}{\partial x^2} - V\frac{\partial C}{\partial x} - \frac{\partial C\mu C}{\partial t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Nomenclature

R = Retardation factor
C = Enteric virus concentration
D = Hydrodynamic Dispersion (cm^2/m)
V = Steady state ground water velocity (cm^2/mm)
μ = Removal rate of coefficient (c/mm)
T = Time [T]
X = Distance [M]
ϕ = Porosity [-]

$$R\frac{\partial^2 C_1}{\partial t} = D\phi\frac{\partial^2 C_1}{\partial x^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$\left.\begin{array}{l} t = 0 \\ x = 0 \\ C_{(o)} = 0 \\ \left.\dfrac{\partial C}{\partial t}\right|_{t = 0, B} = 0 \end{array}\right\} \quad \ldots\ldots\ldots\ldots \quad (3)$$

$$R\frac{\partial C_2}{\partial t} = V\frac{\partial C^2}{\partial x} \quad \ldots\ldots\ldots\ldots \quad (4)$$

$$\left.\begin{array}{l} t = 0 \\ x = 0 \\ C_{(o)} = 0 \\ \left.\dfrac{\partial C}{\partial t}\right|_{t = 0, B} \end{array}\right\} \quad \ldots\ldots\ldots\ldots \quad (5)$$

$$R\frac{\partial C_3}{\partial t} = -\frac{\partial C_3 \mu c}{\partial t} \quad \ldots\ldots\ldots\ldots \quad (6)$$

$$\left.\begin{array}{l} t = 0 \\ C_{(o)} = 0 \\ \left.\dfrac{\partial C_3}{\partial t}\right|_{t = 0, B} = 0 \end{array}\right\} \quad \ldots\ldots\ldots\ldots \quad (7)$$

$$V\frac{\partial C_4}{\partial x} - \frac{\partial C_4 \mu c}{\partial t} \quad \ldots\ldots\ldots\ldots \quad (8)$$

$$\begin{array}{l} x = 0 \\ t = 0 \\ C_{(o)} = 0 \\ \left.\dfrac{\partial C_4}{\partial x}\right|_{x = 0, B} = 0 \end{array} \quad \ldots\ldots\ldots\ldots \quad (9)$$

$$D\phi\frac{\partial^2 C_5}{\partial x^2} - V\frac{\partial C_5}{\partial x} \quad \ldots\ldots\ldots\ldots \quad (10)$$

$$\begin{array}{l} x = 0 \\ C_{(o)} = 0 \end{array} \quad \ldots\ldots\ldots\ldots \quad (11)$$

$$\left.\frac{\partial C_5}{\partial x}\right| \quad x = 0, \ B$$

Applying direct integration on (2)

$$R\frac{\partial C_1}{\partial t} = D\phi C + K_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

Again, integrate equation (12) directly yield

$$RC = D\phi Ct + Kt + K_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

Subject to equation (3), we have

$$RC_o = K_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (14)$$

And subjecting equation (12) to (3) we have

At $\left.\frac{\partial C_1}{\partial t}\right|_{t=0} = 0 \quad C(o) = Co$

Yield

$$0 = D\phi C_o + K_2$$

$$\Rightarrow R_1 = D\phi C_o = K_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (15)$$

So that we put (13) and (14) into (13), we have

$$RC_1 = D\phi C_{1t} - D\phi Cox \ RCo \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (16)$$

$$RC_1 - D\phi C_{1x} = RC_o - D\phi Cox \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (17)$$

$$C_1 = C_o \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (18)$$

The expression in (18) shows that at any given distance x, we have stable concentration of the pollutant in the system. Most case the microorganisms build up steady migration under the influences of formation variations in the system, the deposition of permeability in soil definitely defined the rate the stratification setting of the formation in any usual state, therefore steady concentration are reflected from the structural deposition of the formation and it characteristics, these influences generate constant concentration in some region of the formation. The derived solution expressed in the system as one of the condition that be experiences on the transport process of bacillus under the influences of permeability coefficients and velocity of flow in soil and water environment.

Hence equation (18) entails that at any given distance x, we have constant concentration of the contaminant in the system.

$$R\frac{\partial C_2}{\partial t} = -V\frac{\partial C^2}{\partial x} \quad \ldots\ldots\ldots\ldots\ldots \quad (4)$$

We approach the system, by using the Bernoulli's method of separation of variables

$$C_2 = XT \qquad \ldots\ldots\ldots\ldots \qquad (19)$$

i.e. $$R\frac{\partial C_2}{\partial t} = XT^1 \qquad \ldots\ldots\ldots\ldots \qquad (20)$$

$$V\frac{\partial C_2}{\partial x} = X^1T \qquad \ldots\ldots\ldots\ldots \qquad (21)$$

Put (20) and (21) into (19), so that we have

$$RXT^1 = -VX^1T \qquad \ldots\ldots\ldots\ldots \qquad (22)$$

i.e. $$R\frac{T^1}{T} = V\frac{X^1}{X} = -\lambda^2 \qquad \ldots\ldots\ldots\ldots \qquad (23)$$

Hence $$R\frac{T^1}{T} + \lambda^2 = 0 \qquad \ldots\ldots\ldots\ldots \qquad (24)$$

i.e. $$X^1 + \frac{\lambda}{R}x = 0 \qquad \ldots\ldots\ldots\ldots \qquad (25)$$

$$VX^1 + \lambda^2 X = 0 \qquad \ldots\ldots\ldots\ldots \qquad (26)$$

From (25), $$X = ACos\frac{\lambda}{R}X + BSin\frac{\lambda}{\sqrt{R}}X \qquad \ldots\ldots\ldots\ldots \qquad (27)$$

And (20) gives

$$T = C\ell^{\frac{-\lambda^2}{V}t} \qquad \ldots\ldots\ldots\ldots \qquad (28)$$

And (20) gives

$$\boxed{C_2 = \left(ACos\frac{\lambda}{\sqrt{R}}t + BSin\frac{\lambda}{\sqrt{R}}t\right)C\ell^{\frac{-\lambda^2}{V}x}} \qquad \ldots\ldots\ldots\ldots \qquad (29)$$

Subject to equation (29) to conditions in (5), so that we have

$$C_o = AC \qquad \ldots\ldots\ldots\ldots \qquad (30)$$

Equation (30) becomes

$$C_2 = C_o \ell^{\frac{-\lambda^2}{V}x} Cos \frac{\lambda}{\sqrt{R}}t \quad \ldots\ldots\ldots\ldots \quad (31)$$

Again, at

$$\left.\frac{\partial C_2}{\partial t}\right|_{t = 0,\ B} = 0,\ x = 0$$

Equation (31) becomes

$$\frac{\partial C_2}{\partial t} = \frac{\lambda}{\sqrt{R}} C_o \ell^{\frac{-\lambda}{V}x} Sin \frac{\lambda}{\sqrt{R}} t \quad \ldots\ldots\ldots\ldots \quad (32)$$

i.e. $0 = -\frac{Co\lambda}{\sqrt{R}} Sin \frac{\lambda}{\sqrt{R}} 0$

$Co \frac{\lambda}{\sqrt{R}} \neq 0$ Considering NKP

Which is the substrate utilization for microbial growth (population) so that

$$0 = Co \frac{\lambda}{\sqrt{R}} Sin \frac{\lambda}{\sqrt{R}} B \quad \ldots\ldots\ldots\ldots \quad (30)$$

$$\Rightarrow \frac{\lambda}{R} = \frac{n\pi}{2} n, 1, 2, 3 \quad \ldots\ldots\ldots\ldots \quad (34)$$

$$\Rightarrow \lambda = \frac{\lambda}{R} = \frac{n\pi\sqrt{R}}{2} \quad \ldots\ldots\ldots\ldots \quad (35)$$

So that equation (31) becomes

$$\Rightarrow C_2 = Co \ell \frac{-n^2\pi^2 R}{2} t\ Cos \frac{n\pi\sqrt{R}}{2\sqrt{R}} x \quad \ldots\ldots\ldots\ldots \quad (36)$$

$$\Rightarrow C_2 = Co \ell \frac{-n^2\pi^2 R}{2} t\ Cos \frac{n\pi}{2} x \quad \ldots\ldots\ldots\ldots \quad (37)$$

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Now, we consider equation (7), we have the same similar condition with respect to the behaviour

$$R\,\frac{\partial C_3}{\partial t} = -\,\frac{\partial C_3 \mu C}{\partial t} \qquad \text{……………………} \qquad (6)$$

$$C_3 \;=\; XT^1 \qquad \text{…………………………..} \qquad (38)$$

$$\frac{\partial C_3}{\partial t} = XT^1 \qquad \text{…………………………..} \qquad (39)$$

i.e. $R\,\dfrac{\partial C_3}{\partial t} = XT^1$ ………………………….. (40)

Put (20) and (21) into (19), so that we have

$$RXT^1 = -\,XT^1 \mu C \qquad \text{…………………………..} \qquad (41)$$

i.e. $R\dfrac{T^1}{T} = -\dfrac{T^1}{T}\mu C - \lambda^2$ ………………………….. (42)

$$R\frac{T^1}{T} + \lambda^2 = 0 \qquad \text{…………………………..} \qquad (43)$$

$$X^1 + -\frac{\lambda}{R}\varphi = 0 \qquad \text{…………………………..} \qquad (44)$$

And $RT^1 + \lambda^2 t = 0$ ………………………….. (45)

From (44), $t = ACos\,\dfrac{\lambda}{R}t + B\,Sin\dfrac{\lambda}{\sqrt{R}}t$ ………………….. (46)

and (39) give

$$\boxed{T = C\,\ell\,\frac{-\lambda^2}{\mu C}t}$$

………………………….. (47)

By substituting (46) and (47) into (38), we get

$$C_3 = \left(ACos\,\frac{\lambda}{R}t \ + \ B\,Sin\frac{\lambda}{\sqrt{R}}t \right) C\,\ell\ \frac{-\lambda^2}{\mu C}t$$

……………… (48)

Subject equation (48) to conditions in (7), so that we have

$$Co \ = \ AC$$ ………………………….. (49)

Equation (49) becomes

$$C_3 \ = Co\,\ell\ \frac{-\lambda^2}{\mu C}t\ Cos\ \frac{\lambda}{R}t$$ ………………………….. (49)

Again, at $\left.\frac{\partial C_3}{\partial t}\right|_{t\ =0,B} = 0 \ \ t = \ 0$

Equation (50) becomes

$$\frac{\partial C_3}{\partial t} = \frac{\lambda}{R}\ Co\,\ell\ \frac{-\lambda}{\mu C}t\ Sin\ \frac{\lambda}{R}t$$ ………………………….. (51)

i.e. $0 = \ Co\frac{\lambda}{R}\ \ Sin\ \frac{\lambda}{R}0$

$Co\frac{\lambda}{R}\ \neq\ 0$ Considering NKP again

Due to the rate of growth, which is known to be the substrate utilization of the microbes we have

$$0 = -Co\frac{\lambda}{\sqrt{R}}\ Sin\ \frac{\lambda}{\sqrt{R}}B \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \qquad (52)$$

The migration system of virus has been express in numerous circumstance base of the geological setting of the soil, micronutrients deposition in formation of these type of soil are observed several microelements concentration considered as it varies in its deposit in some part of the region, the depositions of micronutrients are found to enhance the population of enteric virus in the formation, the concentration escalating with respect to formation characteristics in the soil formation, the population increase in the formation are influenced by the rate of permeability and high degree of porosity of the soil, the transport of enteric virus are influenced by these stated parameters including other inhibitors in transport system, the expressed derived solution at these condition considered these conditions in sequenced through to mathematical approach to expressed these condition of transport process of bacillus in substrate condition in the formations.

$$\Rightarrow \frac{\lambda}{R} = \frac{n\pi}{2}n,1,2,3 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \qquad (53)$$

$$\Rightarrow \lambda = \frac{n\pi\sqrt{R}}{2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \qquad (54)$$

So that equation (50) becomes

$$C_3 = Co\ell\ \frac{-n^2\pi^2 R}{2\mu C}t\ Cos\frac{n\pi}{2}t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \qquad (55)$$

Now, we consider equation (8), we have

$$V\ \frac{\partial C_4}{\partial x} - \frac{\partial C_4 \mu C}{\partial t} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (8)$$

Using Bernoulli's method, we have

$$C_4 = XT \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \qquad (56)$$

$$\frac{\partial C_4}{\partial x} = X^1T \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \qquad (57)$$

$$\frac{\partial C_4}{\partial t} = XT^1 \qquad \text{.............................} \qquad (58)$$

Put (57) and (58) into (56), so that we have

$$VX^1T = -XT^1\mu C \qquad \text{.............................} \qquad (59)$$

i.e. $V\frac{X^1}{X} = -\frac{T^1}{T}\mu C$ .... (60)

$$V\frac{X^1}{X} = \varphi \qquad \text{.............................} \qquad (61)$$

$$\frac{T^1}{T}\mu C = \varphi \qquad \text{.............................} \qquad (62)$$

$$X = A\,\ell\,\frac{\varphi}{V}t \qquad \text{.............................} \qquad (63)$$

Put (62) and (63) into (56), gives

$$C_4 = A\,\ell\,\frac{\varphi}{\mu C} \bullet B\,\ell\,\frac{-\varphi}{\mu C}x \qquad \text{.............................} \qquad (64)$$

$$C_4 = AB\,\ell^{(t-x)}\frac{\varphi}{\mu C} \qquad \text{.............................} \qquad (65)$$

Subject equation (66) to (8)

$$C_4\ (o) = Co \qquad \text{.............................} \qquad (66)$$

So that equation (67) becomes

$$\boxed{C_4 = Co\,\ell^{(t-x)}\frac{\varphi}{\mu C}} \qquad \text{.............................} \qquad (67)$$

Considering equation (10), we have

$$D\phi \frac{\partial^2 C_5}{\partial x^2} - V \frac{\partial C_5}{\partial x} \quad \ldots\ldots\ldots\ldots (10)$$

$$C_5 = XT \quad \ldots\ldots\ldots\ldots (68)$$

$$\frac{\partial^2 C_5}{\partial x^2} + X^{11}T \quad \ldots\ldots\ldots\ldots (69)$$

$$\frac{\partial C_5}{\partial x} + X^1 T \quad \ldots\ldots\ldots\ldots (70)$$

Put (69) and (70), so that we have

$$D\phi X^{11}T - VX^1 T \quad \ldots\ldots\ldots\ldots (71)$$

$$D\phi \frac{X^{11}}{X} T - V \frac{X^1}{X} \quad \ldots\ldots\ldots\ldots (72)$$

$$D\phi \frac{X^{11}}{X} = \varphi \quad \ldots\ldots\ldots\ldots (73)$$

$$V \frac{X^1}{X} = \varphi \quad \ldots\ldots\ldots\ldots (74)$$

$$X^1 = A\ell \frac{\varphi}{D\phi} x \quad \ldots\ldots\ldots\ldots (75)$$

Put (74) and (75) into (68), gives

$$C_5 = A\ell \frac{\varphi}{V} \bullet B\ell \frac{-\varphi}{V} x \qquad \text{..............................} \qquad (76)$$

$$C_5 = AB\ell^{(x-x)} \frac{\varphi}{V} \qquad \text{..............................} \qquad (77)$$

Subject (76) to (10)

$$C_5 \ (o) = Co \qquad \text{..............................} \qquad (78)$$

So that equation (78) becomes

$$C_5 = Co\ell^{(x-x)} \frac{\varphi}{V} \qquad \text{..............................} \qquad (79)$$

Now, assuming that at the steady flow, there is no NKP for substrate utilization, our concentration here is zero, so that equation (79) becomes

$$C_5 = 0 \qquad \text{..............................} \qquad (80)$$

Therefore, $C_1 + C_2 + C_3 + C_4 + C_5$ .... (81)

We now substitute (18), (37), (55), (67) into (81) so that we have the model of the form

$$C = Co + Co\ell \frac{-n^2\pi^2 R}{2V} x \; Cos \frac{n\pi}{2} t \bullet Co\ell \frac{-n^2\pi^2 R}{2\mu C} t \; Cos \frac{n\pi}{2} t +$$

$$Co\ell^{(t-x)} \frac{\varphi}{\mu C} \qquad \text{..............................} \qquad (82)$$

$$\Rightarrow C = Co + 1 + \ell \frac{n^2\pi^2 R}{2V} x \; Cos \frac{n\pi}{2} \bullet Co\ell \frac{-n^2\pi^2 R}{2\mu C} t \; Cos \frac{n\pi}{2} t +$$

$$Co\ell^{(t-x)} \frac{\varphi}{\mu C} \qquad \text{..............................} \qquad (83)$$

The expression in [83] is the generated a models from the overriding equation, the expression from the derived solution are base on the stated functional parameter that influences the deposition of bacillus in soil and water environments, modeling of permeability and porosity of enteric virus transport in the study area are to establish their functional influences in the deposition of enteric virus in the formation, modeling this transport process influenced by this two stated parameters are to express the rate of migration with respect to time under variation of depths, the rate of pollutant are indomitable by the rate of permeability and porosity of flow in the system.

4. Conclusion

Predicting the transport of enteric virus influenced by permeability and porosity of transport is to establish functional thorough setting that determined the influences of the stated parameters in the transport process of enteric virus in the study area. The transport of enteric virus were influenced by permeability and porosity through the stratification deposit under the influences of geomorphology and geochemistry setting of the formation that also influences retardation were examined in the system. This implies that most examined water analysis produced result of microbial contamination reducing with respect to time; definitely there should be a tendency of influences causing the retardation factors in the concentration of enteric virus in the formation. Retardation phase in the deposition of enteric virus may be influences by other minerals as an inhibitor, but the rate of permeability of fluid flow study are carried out to monitor variation of high degree of porosity and permeability in the formation, it has on the retardation phase of enteric virus in the formation. Therefore the expressed mathematical model will definitely determined the rate of retardation of microorganisms enteric virus as well as the express rate porosity and permeability influences in enteric virus deposition in udi Bayelsa state of Nigeria.

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