Open Journal of Environmental Science and Development
Vol. 1, No. 1, November 2013, PP: 01 - 09
Available online at http://scitecpub.com/Journals.php

Research article

UNSTEADY STATE FLOW IN NON REACTIVE MASS TRANSPORT OF ENTEROBACTERIACEAE IN PREDOMINANT SILTY FORMATION OF DEGEMA, RIVERS STATE OF NIGERIA.

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Abstract

The direction of flow in soil are influenced by formation characteristics, but there are other influences that expressed their functions in another direction, these conditions in most case can be insignificant for some certain reason depending on the behaviour of the microbes in the formation, stratification of the formation were monitored on the previous risk assessment carried out in the study location. The results shows that non reactive flow rapidly increase in migration of the microbes in the formation since there are non reactive substance that can inhibit the microbes or cause degradation in terms of death in the formations. Base on these factors mathematical model were fined appropriate to express the migration of enterobacteriaceae in the study area, the developed model were generated through the governing equation expressed from the system, the model were derived considering several conditions including the behaviour of the microbes influenced by formation characteristics. The expressed model will be applied to monitor the deposition and migration of enterobacteriaceae in unsteady state flow in the study area.

Keywords: unsteady state flow, non reactive mass transport, and silty formation.

1. Introduction

With over a billion individual cells and estimates of 104–105 distinct genomes per gram of soil (Gans et al., 2005; Tringe et al., 2005; Fierer et al., 2007b Katherine, 2011), bacteria in soil are the reservoirs for much of Earth's genetic biodiversity. This vast phylogenetic and functional diversity can be attributed in part to the Dynamic physical and chemical heterogeneity of soil, which results in spatial and temporal separation of microorganisms (Papke and Ward, 2004; Eluozo and Afiibor,2013). Given the high diversity of carbon (C) – rich compounds in soils, the ability of each taxon to compete for only a subset of resources could also contribute to the high diversity of bacteria in soils through resource partitioning (Zhou et al., 2002 Katherine et al 2011). Indeed, Waldrop and Firestone (2004) have demonstrated distinct substrate preferences by broad microbial groups in grassland soils and C resource partitioning has been demonstrated to be a key contributor to patterns of bacterial co-existence in model communities on plant surfaces (Wilson and Lindow, 1994). The development of high-throughput tools to assess the composition of soil bacterial communities is rapidly contributing to an improved understanding of bacterial diversity and biogeographically distribution (Drenovsky et al., 2009; Lauber et al., 2009; Chu et al., 2010 Katherine et al 2011). However, our ability to assess the functions of different bacterial taxa has not kept pace (Green et al., 2008). This limits our ability to interpret the functional consequences of shifts in community composition in response to environmental changes (Stein and Nicol, 2011).there several concept applied to monitor the trace of the bacteria For this reason, the use of tracer molecules such as stable-isotopes and the thymidineanalog, 3-bromodeoxyuridine (BrdU), have been widely adopted in an effort to connect phylogeny to function. Stable-isotopes, particularly the heavy carbon isotope 13C, have been frequently used to identify microbial community members capable of catabolizing particular substrates (Radajewski et al., 2000; Griffiths et al., 2004; Buckley et al., 2007; Feth El Zahar et al., 2007; Schwartz, 2007). This technique requires separation of nucleic acids based on buoyant density, so high concentrations of isotopically labeled substrate are needed. Thus, this approach is costly and impractical for many complex organic compounds that are not commercially available. An alternative is the use of BrdU to monitor cell division following substrate addition. This approach was first applied to the study of bacterial populations over a decade ago (Urbach et al., 1999) and it has since been used to identify soil bacterial taxa that respond to various environmental stimuli (Borneman, 1999; Yin et al., 2000; Artursson and Jansson, 2003; Artursson et al., 2005). Recently, BrdU incorporation has been shown to detect a broad diversity of bacterial phyla in marine systems (Edlund et al., 2008) and fungal taxa in temperate (Hanson et al., 2008) and boreal forest soils (Allison et al., 2008 Eluozo and Afiibor, 2013).

2. Theoretical background

The variation of water table in soil are subjected several factors in soil structural deposition, the unsteady state in fluid flow depositing ground water table are influenced by some formation characteristics deposited in the formation, the study area predominantly deltaic formation, there numerous factors that come to play when this challenges are critically evaluated, the rate of unsteady state in the formation are expressed through coefficient of permeability deposition in the deltaic formation, such condition are found to influence the deposition of saturated vadose, another factors are the climatic condition through high rain intensities such situation are part of the influential circumstance that lead to unsteady state water table in deltaic environments, the study centred on the homogeneous flow in unsteady state homogeneous flow in non reactive isotropic mass transport of Enterobacteriaceae that deposit in soil and water environment.

The study express what has influences the fluid flow to be unsteady saturate vadose to the bed rock, the formation variables are the paramount cause of unsteady state for geological formation deposited from aquitard to confined bed. The stratification of deltaic formation are influenced by the variation deposition in the strata , the study focus also in deposited formation where there is nonreactive isotopic mass transport of Enterobacteriaceae in deltaic environment, the dynamic flow are base of the hydraulic conductive base on the high rate of permeability in the formation, the dynamics in fluid flow in deltaic formation can concluded that it variations in deposition are determined by the rate of formation characteristics that generated the highest degree of the formation influences, this develop unsteady state flow in fluids in deltaic formations. The development of mathematical model were to express unsteady state fluid flow on mass transport of Enterobacteriaceae deposition, this include formations influence to develop the rate of migration under unsteady state condition in the study area. Mores so several experts in previous decade try to model this fluid dynamic and its variation in different strata but they could not develop it in plug flow application further more from other experts in fluid there has been the concept of continuity equation for flow. But this water flow, as we learnt in the previous time, is due to a difference in potentiometric head per unit length in the direction of flow. A relation between the velocity and potentiometric gradient was first suggested by Henry Darcy, a French Engineer, in the mid nineteenth century. He found experimentally that the discharge 'Q' passing through a tube of cross sectional area 'A' filled with a porous material is proportional to the difference of the hydraulic head 'h' between the two end points and inversely proportional to the flow length's. It may be noted that this velocity is not quite the same as the velocity of water flowing through an open pipe. In an open pipe, the entire cross section of the pipe conveys water. On the other hand, if the pipe is filed with a porous material, say sand, then the water can only flow through the pores of the sand particles. Hence, the velocity obtained by the above expression is only an apparent velocity, with the actual velocity of the fluid particles through the voids of the porous material is many time more. But for our analysis of substituting the expression for velocity in the three directions x, y and z in the continuity relation, equation.

The forecast of state variables that describe flow and solute transport in a given aquifer can be obtained by solving the *mathematical model* that describes these phenomena. Such a model is based on a *conceptual* model that includes a set of verbal statements introducing a simplified version of the various physical, chemical, and biological aspects of the flow domain and the phenomena of transport that take place in it. Because, in most cases of practical interest, analytical solutions of the mathematical models are not possible, the mathematical models are transformed into *numerical models*.

3. Governing equation

$$Vn\frac{\partial C}{\partial t}(x,t) = nV_x\frac{\partial C}{\partial x}(x,t) + nD\frac{\partial^2 C}{\partial x^2}(x,t) \quad \text{.....................} (1)$$

The expression here is the principal equations developed to monitor the unsteady state condition of entrobacterialcea, the deposition of the microbes are predominant silty formation, the stratum also deposit unsteady state fluid flow in non reactive condition. These expression were confound from previous risk assessment, but could not develop permanent result to prevent the migration of the microbes, base on the factors, mathematical modeling techniques were applied to monitor the rate of migration on the phase of unsteady state condition in non reactive mineral with the microbes deposited, the system were formulated base on these variables to developed the governing equation stated above.

$$\frac{\partial C}{\partial t} = S^1C(t) - C(o) \quad \text{.....................} (2)$$

$$\frac{\partial C}{\partial x} = S^1C(x) - C(o) \quad \text{.....................} (3)$$

$$\frac{\partial^2 C}{\partial x^2} = S^{11}C(x) - S^1C(o) - C(o) \quad \text{.....................} (4)$$

Substituting (2), (3), (4) into equation (1) gives

$$S^1C(t)\ (t) - Vn\left[S^1C(x) - C(o)\right] = Vn\left[SC(x) - C(o)\right] + nD$$
$$\left[S^2C(x) - SC(o) - C(o)\right] \quad \text{.....................} (5)$$

$$S^1(t) - VnS^1C(o) = nVxS^1C(x) + nDS^{11}C(x) - S^1C(x) \quad \text{.....................} (6)$$

$$C(x)\frac{1}{S}\left[VnS^1C(t) - nVxS^1C(x) + nDS^{11}C(x) - S^1C(x)\right] \text{.....................} (7)$$

$$C(x)\frac{1}{S^1}\left[VnS^1C(t) - nVxS^1C(x) + nDS^{11}C(x) - S^1C(x)\right] \text{.....................} \quad (8)$$

$$C(x) = \frac{VnS^1C(t) - nVxC(x) + nDS^1}{S} \quad \text{.....................} (9)$$

$$C(x) = VnC(t) - nVxC^1(x) + nDC^{11} \quad \text{.....................} (10)$$

$$C(x) = \frac{VnS^1C(t) = nVx + nDS^1}{S} \quad \text{.....................} (11)$$

$$C(x) = \left[Vn - nVx + nDS^{11}\right]C(t) \quad \text{.....................} (12)$$

$$S^1C(x) = \left[Vn - nVx + nDS^{11}\right]C(t) \quad \text{.....................} (13)$$

$$C(x) = \frac{S^1C(x)}{Vn + nVxS^1 + nDS^{11}} \quad \text{.....................} (14)$$

$$C(t) = \frac{S^1(x)}{Vn + nVx + nD} \quad \text{.....................} (15)$$

Furthermore, considering the boundary condition, we have

$$\text{At } t = 0 \quad C^1(o) = C(o) = 0 \quad \text{.....................} (16)$$

$$VnS^1 C(t) - nVxS^1 C(x) + nDS^{11}\ S^1C(x)C(o) = 0 \quad \text{.....................} (17)$$

$$C(t) = \frac{0}{Vn - nVxS^1 + nDS^{11}} \quad \text{.....................} (18)$$

Considering the following boundary condition when

$$\text{At } t > 0 \quad C^1(o) = Co \quad \text{.....................} (19)$$

Applying the boundary condition into this equation

$$VnS^1C(t) - VnC(o) - Vn - nVxS^1 C(x) - nVxCo - S(x) + nDS^{11}$$

$$C(x) + nDCo + S^1C(x) \quad \text{.....................} (20)$$

$$VnC(t) - VnxC(x) = nVxSC(o)\ VnCo - nVxCo + nDC(o) \quad \text{.................} (21)$$

$$C(t) = \left[VnS - Vn - nVx + nD\right]Co \quad \text{.....................} (22)$$

$$C(t) = VnS - Vn - nVx + nD\ Co \quad \text{.....................} (23)$$

$$C(t) = \left(\frac{VnS - Vn - nVx + nD}{VnS - Vn - nVx + nD}\right) Co \quad \text{.....................} (24)$$

Applying quadratic expression to determine denomination for the equation

$$Vn - nVx + nD = 0 \qquad \text{.....................} \quad (25)$$

Applying quadratic expression, we have

$$s = \frac{-b \pm \sqrt{b^2 - 4ac}}{2ac} \qquad \text{.....................} \quad (26)$$

Where $a = Vn$, $b = nVx$ and $c = nDCo$

$$X = \frac{-C_1 + \sqrt{C_1{}^2 - 4C_2 \frac{\lambda^2}{\theta wV}}}{2\theta wV} \qquad \text{..............................} \quad (27)$$

$$X = \frac{-C_1 - \sqrt{C_1{}^2 - 4C_2 \frac{\lambda^2}{\theta wV}}}{2\frac{\lambda^2}{\theta wV}} \qquad \text{..............................} \quad (28)$$

Substituting equation (20) to the following condition and initial values condition.

$$t = 0, C = 0 \qquad \text{..............................} \quad (29)$$

Therefore, $X_{(x)} = C_1 e^x - e^{-mx} + C_2 M^{em2x}$ .... (30)

$$C_1 \, Cos \, M_{1x} + C_2 \, Sin \, M_{2x} \qquad \text{..............................} \quad (31)$$

$$y = \frac{\lambda^2}{\theta wV} + C_1 + C_2 \qquad \text{..............................} \quad (32)$$

$$C(x,t) = \left[C_1 \, Cos \, M_1 \frac{\lambda^2}{\theta wV} x + C_2 \, Sin \, M_2 \frac{\lambda^2}{\theta wV} x \right] \text{..............} \quad (33)$$

But if $x = \frac{v}{t}$

Therefore, equation (33) can be expressed as:

$$C(x,t) = \left[C_1 \, Cos \, M_1 \frac{\lambda^2}{\theta w V} \frac{v}{t} + C_2 \, Sin \, M_2 \frac{\lambda^2}{\theta w V} \frac{v}{t} \right] \ldots\ldots\ldots\ldots\ldots \quad (34)$$

Unsteady state flow in non reactive mass transport of enterobacteriaceae in predominant silty formation, it will be monitored by application of this final expression in [34], the developed model were to showcase various ways of structural deposition of the strata influenced in the study location. The studies are in line with mass transport behaviour of enterobacteriaceae in soil and water environment. Such deposition were integrated to expressed the final governing equation, the express model considered several conditions that influences unsteady state flow in the formations, it also include the variation influences of the deposited formation characteristics in the study area, furthermore, the deposition of the formation are streamline to establish various behaviour in terms of migration behaviour of the microbes in the study location.

4. Conclusion

The deposition of non reactive influences on the transport of enterobacteriaceae has been expressed in the derived solution; the developed derived model will definitely monitor the deposition and migration of enterobacteriaceae under the influences of formation characteristics in the study area. Such expression has detailed the rate of influences on the migration in non reactive phase of the system in terms of enterobacteriaceae in soil and water environment. More so, other expert has express various concepts on the deposition of groundwater flow models based on the differential equations for groundwater flow. Such differential equations, as described in Hydrodynamics of Groundwater**,** are usually based on Darcy's Law as the linear macroscopic fluid momentum balance equation, considering the drag terms of the Navier Stokes equation as dominant, and on the principle of the fluid mass conservation. Depending on the special features of the situation to be modeled, different circumstances have to be taken into account. A model for a confined aquifer is different from that for an unconfined (phreatic) aquifer. The spatial dimensionality (1D or 2D or 3D) depends on the physical situation and the aim of modeling. Depending on the very same aspects, a decision about steady state versus unsteady simulations has to be taken, just to name the most basic properties of a model.

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