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Research article

PREDICTING THE TRANSPORT AND DISPERSIVITY RATE OF LACTOBACILLUS ON LATERITIC AND SILTY SOIL FORMATION IN OBIOAKPOR METROPOLIS NIGER DELTA OF NIGERIA

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Abstract

The prediction of lactobacillus transport under permeation and dispersivity pressures in deltaic formation has been through investigated; these were evaluated at various rate of accumulation in lateritic and silty soil formation. The study observed numerous negative impact of transport and dispersivity contaminant in lateritic and silty formation, these lithology experiences recurrent exploitation through man made activities, elevated accumulation has generated several migration of these type of microbial species on the formations, but the leading depositional pressures in the formation has generated lot of vacillation, consequently, it has generated negative impact in unconfined beds, these was observed through monitoring of the solute transport experienced through the rate of accumulations in some strata under the influences of low deposition of permeability in silty formation. Mathematical modeling approach were found imperative on these situation, the expressed model were developed through the generated system. The developed model from the derived solution has produces model in different phase, the model will definitely be a useful tools in monitoring and evaluation of lactobacillus accumulation in the study location.

Keywords: prediction, lactobacillus transport, dispersivity lateritic and silty soil.

1. Introduction

Direct measurement of pore pressure and hydrologic properties will strengthen our understanding of fundamental geological processes. We continue to debate the relationship between pore pressure and faulting in accretionary prisms [Davis, et al., 1983; Dahlen, et al., 1984; Saffer and Bekins, 2002]. Pore pressure is thought to have a role in the earthquake cycle [Sibson, 1981]. In hydrate systems, pore pressure may control how free gas is trapped and migrates [Hyndman and Davis, 1992; Holbrook et al., 2002; Flemings, et al., 2003, Eluozo 2013]. Pore pressure is known to have an effect on the potential for submarine landslides [Dillon, et al., 2000; Dugan and Flemings, 2000; 2002]. Despite its importance, we are only beginning to learn how to directly measure pressure in low permeability sediments. In the Ocean Drilling Program, two techniques have been used. Permanent borehole installations (CORKs, ACORKs) have isolated parts of the formation to monitor pressure [Davis, 1992; Davis and Becker, 1994; Becker, et al., 1997] and Penetrometer have been developed [Davis, 1997; Taylor, et al., 2000].

The induced pore pressure and its subsequent dissipation are constrained by the strength of the sediment and its consolidation coefficient. The initial excess pore pressure after penetration can be used to estimate the shear modulus of the sediments if conditions are undrained [*Randolph and wroth*, 1979a]. The pressure dissipation is used to infer in situ pore pressure and the coefficients of consolidation [Randolph and Wroth, 1979a; Gupta and Davidson, 1986], which can be used to infer permeability.

2. Theoretical background

The behaviour of the system was expressed through mathematical application to monitor the structure strata influences on dispersivity of lactobacillus in lateritic and silty formation. The system were examined thoroughly to determine the most pressured variables that developed the impact on the migration of lactobacillus in the strata, these study become imperative due to several dispersivity influences examined in the formation on critical assessment of rate of pollution deposited in lateritic and silty formation, high content observed from the investigation reveal the rate of accumulation deposited between these two strata. The study observed several impacts from some low predominant formation characteristics in the study locations, such condition were critically evaluated in the system to produces the governing equation, the mathematical derived solution consider several conditions base on the behaviour of the microbes influenced by dispersivity in lateritic and silty formations. The system will also monitor the rate accumulation influences by low permeability that may generate high accumulation of the microbes between the studied formations; the expressed model at various phase of the transport system are influenced by these variable, this will be integrated to generate the final model for the study.

3. Governing equation

$$K\frac{\partial c}{\partial t} = -\phi K_d \frac{\partial c}{\partial Z} + \alpha \iota Vs \frac{\partial^2 c}{\partial x^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

The expression in equation [1] establish the deposition of lactobacillus in soil and water environment, the generated governing equation should evaluated the contaminant deposition under the influences on migration phases in the transport process; this has developed lots of predictions that imperative to examine in the study area, consideration of lactobacillus process developed better understanding of dispersivity influences on contaminants in deltaic formations, the developed governing equation will definitely expressed low permeability influences from lactobacillus transport under plug flow condition.

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Substituting solution $C = TZ$

$$kZ^1T = \phi K_d Z^1 T + \alpha \iota Vs \frac{Z^{11}T}{Z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (2)$$

Dividing it by ZT

$$\mathrm{K}\frac{Z^1T}{Z} = -\phi K_d \frac{Z^1T}{Z} + \alpha \iota Vs \frac{Z^{11}T}{Z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (3)$$

$$K\frac{T^1}{T} = -\phi K_d \frac{Z^1}{Z} + \alpha \iota Vs \frac{Z^1}{Z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (4)$$

$$K\frac{T^1}{T} = -\alpha \iota Vs \frac{Z^{11}}{Z} - \phi K \frac{Z^1}{Z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (5)$$

Considering when $Ln\, Z \to 0$

$$K\frac{T^1}{T} = \phi K \frac{Z^1}{Z} - \alpha \iota Vs \frac{Z^{11}}{Z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (6)$$

$$K\frac{T}{T} = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (7)$$

$$\alpha \iota Vs \frac{Z^{11}}{Z} = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (8)$$

$$\phi K = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (9)$$

$$\phi K \frac{Z^1}{Z}\frac{dy}{dy} = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (10)$$

$$\alpha \iota Vs \frac{dy}{dz} = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (11)$$

$$\phi K \frac{Z^1}{Z}\frac{dy}{dz} = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (12)$$

$$\frac{dy}{dz} = \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (13)$$

$$\frac{dy}{dz} = \frac{\lambda^2}{Vs} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (14)$$

$$dy = \left(\frac{\lambda^2}{\phi K}\right) dz \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (15)$$

$$\int dy = \int \frac{\lambda^2}{\phi K} dz \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (16)$$

$$dy = \frac{\lambda^2}{\phi K} z\, dy \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (17)$$

$$\int dy = \int \frac{\lambda^2}{\phi K} z\, dy + C_1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (18)$$

$$y = \frac{\lambda^2}{\phi K} z + C_1 z + C_2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (19)$$

$$y = \frac{\lambda^2}{\phi K} z + C_1 + C_2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (20)$$

$$y = 0$$

$$\boxed{y = \frac{\lambda^2}{\phi K} z + C_1 + C_2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (21)$$

The derived solution on this phase are influenced by low permeability on its contaminant process, the low rate of porosity are also observed to be part of the influences but not predominant at this phase due its relationship it has with permeability, it was streamlined with low permeability deposition on the derived process to ensure that the parameters that are part of the developed system expressed their functions in terms of slight permeability pressures with the contaminant through the structured strata in the study location, such expression were developed at the phase of the model in [21] were the rate of lowest deposition of formation characteristics, this may have developed accumulation with any deposited contaminant.

$$\Rightarrow y = \frac{\lambda^2}{\phi K} z + C_1 + C_2 = 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (22)$$

Applying quadratic expression, we have:

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (23)$$

$$X = \frac{-(C) \pm \sqrt{(C)^2 - 4\frac{(\lambda^2)}{Vs}C_2}}{2\frac{X}{\phi K}} \qquad \text{.......................................} \qquad (24)$$

$$= \frac{-C_1 + \sqrt{C_1{}^2 - 4C_2\frac{\lambda^2}{\phi K}}}{2\frac{X^2}{\phi K}} \qquad \text{.......................................} \qquad (25)$$

$$X = \frac{-C_1\sqrt{C_1{}^2 - 4C_2\frac{\lambda^2}{\phi K}}}{2\frac{X^2}{\phi K}} \qquad \text{.......................................} \qquad (26)$$

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

$$X = \frac{C_1 - \sqrt{C^2 - \frac{4C_2\lambda^2}{\phi K}}}{2\frac{X^2}{\phi K}} \qquad \text{.......................................} \qquad (28)$$

Substituting equation (28) to the following boundary condition and initial values condition

$$t = 0, \;\; c = C_o \qquad \text{.......................................} \qquad (29)$$

Therefore, $X(z)\; C_1\,\ell^{-M_z} + C_2\,\ell^{M_2 z}$ .... (30)

$$C_1\,Cos\,M_1 x + C_2\,Sin\,M_2 x \qquad \text{.......................................} \qquad (31)$$

$$y = \frac{\lambda^2}{\phi K} + C_1 + C_2 \qquad \text{.......................................} \qquad (32)$$

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$$\boxed{(x,t) = \left(C_1 \, Cos \, M_1 \frac{\lambda^2}{\phi K} z \; + C_2 \, Sin \, M_2 \frac{\lambda^2}{\phi K} z \right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (33)$$

But if $x = V.T$

And T = $\frac{d}{v}$ we have

Therefore, equation (33) can be expressed in this form

$$\boxed{C(x,t) = \left(C_1 \, Cos \, M \frac{d}{v} \; + C_2 \, Sin \, M_2 \frac{d}{v} \right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (34)$$

$$\boxed{C(x,t) = \left(C_1 \, Cos \, M_1 V.t \; + C_2 \, Sin \, M_2 V.t \right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (35)$$

Development from [33], [34] and [35] are the final model for the accumulation transport of lactobacillus, the behaviour of solute transport process has been investigated to have influences on several dynamic conditions, the deltaic soil has lots of influence due to different formation variation deposited in the study area, such geological factors are reflected on the deposition stated on the contaminant influenced by slight deposition of permeability and porosity in lateritic and silty formation. The behaviour of lactobacillus has been monitored at various dimension on its transport process, this situation should affected the concentration and migration process of lactobacillus, these phase of solute migration process in deltaic formation if not address will affect monitoring and assessment deposition of the strata, because the true concentration of the lactobacillus including other influences that will be identified. The expressed models through the derived solution will definitely produces different results under various noted influences in the system from the expressed developed model for the study.

4. Conclusion

The behaviuor of lactobacillus pressures in deltaic formation has been the subject of concern in the study area. The foundations of these transport process are base on the deposition including the migration process from the examinations carried in the study location, such stages of transport system has cause insufficient information to engineer its rate of concentration by monitoring and evaluation of lactobacillus in deltaic formation, the situation express the reflection from the pressure dispersivity and low permeability deposition, the developed mathematical model are base on the expressed situations examined in the study area, the developed model from the derived solution will definitely streamline several condition noted in the behaviour of lactobacillus influences on the study area.

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