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Research article

MODELING DEPOSITION AND DISPERSION OF CARBON INFLUENCE ON ENTEROMOBACTER TRANSPORT IN LATERITIC SOIL FOMATION IN ELEME, RIVERS STATE OF NIGERIA

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Abstract

The deposition of microelement in lateritic soil has been found to deposit high rate of accumulation in the study area, the deposition of the microelement were confirmed from an evaluation analysis carried out to determine the rate of lateritic soil pollution in the study area. The deposition found to generates high percentage of carbon that are reflected on the increase of microbial population in lateritic soil formation, subject to this relation, the increase of this contaminant are base on the deposition of carbon which express the increase of microbial pollution in lateritic soil, such conditions implies that there the tendency of dispersion under the influences of high degree of saturation from high rain intensities in the study area. To stop further migration within the region of lateritic soil, there must be a preventive approach that will stop further migration from lateritic soil formation, the application of mathematical modeling approach were find suitable in the study, the governing equation were develop base on the parameters that cause the deposition and migration of enteromobacter in lateritic soil formation, the derived model equation apply different approach to derived the model that will prevent further migration in the study area .

Keywords: modeling deposition, dispersion, carbon, enteromobacter transport and lateritic soil

1. Introduction

The efficiency microorganisms to be exchange ass wrapped up soil microelements carbon into microbial biomass have been called the Microbial increase effectiveness (Y), carbon-use efficiency, or microelements -use effectiveness. This physiological facial appearance of the microbial biomass has effectively pressure in overall soil unrefined carbon (SOC) budgets and carbon appropriation in ecosystems (Six et al., 2006). Since: nutrient proportion in microbial biomass vary over comparatively slight ranges Y also contributes to guideline of nitrogen (and other nutrient) mineralization and immobilization in soils (Six et al., 2006). Calibration of microbial growth efficiency in soil span a astonishingly wide range, from 0.14 to 0.77 (Schimel, 1988; Hart et al., 1994; Thiet et al., 2006, Eluozo, 2013). Notwithstanding the high unpredictability of this integrative trait and its significance in influencing organic matter turnover and nutrient accessibility, we have limited understanding of how ecological variables influence growth efficiency (Frey et al., 2001; Six et al., 2006; Thiet et al., 2006). The amount and formation of the soil microbial inhabitants is a role of net major creation, plant carbon (C) portion, rhizosphere activity, and litter microelements dominance (Smith and Paul, 1990; Fisk and Fahey, 2001; Myers et al., 2001), and is regulate through complex interactions with plants (Zak et al., 2000; Bohlen et al., 2001; Butler et al., 2004). Changes in atmospheric CO2 concentration and nitrogen (N) deposition rates alter both the quality and amount of greater than- and belowground plant litter inputs to soil (Aber et al., 1993; Canadell et al., 1996), which in turn can influence belowground microbial society arrangement and function (Phillips et al., 2002; Frey et al., 2004; Waldrop et al., 2004). Considering the mechanisms controlling belowground C processes is useful in predicting future changes in soil C stores in response to climate and land-use change (Pendall et al., 2004). Altering root and coarse woody debris (CWD) inputs to soil is one method to examine the feedbacks between plants, microbes, and soil organic matter (SOM) dynamics (Nadelhoffer et al., 2004). In a Douglas-fir forest, 7 y of CWD additions and litter and root Exclusion have produced significant changes in annual soil CO2 efflux (Sulzman et al., 2005,Eluozo 3013).

2. Theoretical background

The deposition microelements in soil and water environments are not found to be significant to expert in pollution transport studies, several pollution from microbes keep on increasing and yet the sources of increase are only attributed to regeneration of indiscriminate dump of waste in the environments, but it has now been confirm in the study area that it is not only such waste generation that actually increase the deposition of microbes in soil and water environments the express condition of microelement carbon were found to deposition in natural condition without manmade activities, although it has been found that the increase of the microelements are the integration of manmade activates in some area but not often. The study focuses on the establishing of carbon deposition in natural condition and its rate of dispersion under the influences of geomorphology and geochemistry at natural condition, these expression reflect the situation were reaction on the microbial worlds are effective or where there tendency of other mineral developing competitions for inhibition or increase in deposition of microbes in soil and water environments., these condition need to express some prediction and monitoring the reaction and deposition of microelement including their various concentration in lateritic soil were accumulation may be found at high percentage in the study area, such condition call for mathematical expression to defined various condition that reflect the deposition and migration enteromobacter in lateritic soil, the deposition of this microbes in this formation reflect low permeability of the formation and as such increase accumulation of the carbon that increase microbial population of enteromobacter in the study area.

3. Governing equation

$$V\frac{\partial C}{\partial t} = \frac{\partial C}{\partial z} q_z C_s + D_s \frac{\partial Cs}{\partial z} - M_b \frac{\mu_o}{\gamma_o}\frac{\partial Cs}{\partial z} + \frac{Cs}{K_{So} + Cs}\frac{\partial Cs}{\partial t} + \frac{C_A}{K_{Ao} + C_A}\frac{\partial Cs}{\partial z} \quad \ldots \quad (1)$$

The expression is the governing equation to monitor the deposition and dispersion of carbon on enteromobacter transport in lateritic soil, the formation are found to deposit low permeability in the formation developing lot of accumulation in lateritic soil, the deposition of this formation are monitored within a region of the soil, the study has express the rate of carbon deposition which can be naturally or manmade activities, therefore the study from lateritic soil give insight from it rate of deposition the level it will further increase on movement of migration of enteromobacter in lateritic soil to another formation .

$$V\frac{\partial C_1}{\partial t} = q_z C_{s_1} \frac{\partial Cs_1}{\partial z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$\left.\begin{aligned} t &= 0 \\ z &= 0 \\ Cs_{(o)} &= 0 \\ \frac{\partial Cs_1}{\partial t}\Big| t &= 0 \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$V\frac{\partial Cs_2}{\partial t} = D_s \frac{\partial Cs_2}{\partial z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\left.\begin{aligned} t &= 0 \\ z &= 0 \\ Cs_{(o)} &= 0 \\ \frac{\partial Cs_2}{\partial t}\Big| t &= 0,\ B \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$V\frac{\partial C_3}{\partial t} = - M_b \frac{\mu_o}{\gamma_o}\frac{\partial Cs_3}{\partial z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

$$\begin{aligned} t &= 0 \\ z &= 0 \\ Cs_{(o)} &= 0 \end{aligned} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

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$$\frac{\partial Cs_3}{\partial t}\Big| t = 0,\ B$$

$$V\frac{\partial Cs_4}{\partial t} = \frac{C_A}{K_A + C_A}\frac{\partial Cs_4}{\partial z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

$$\left.\begin{array}{l} t = 0 \\ z = 0 \\ Cs_{(o)} = 0 \\ \frac{\partial Cs_4}{\partial t}\Big| t = 0,\ B \end{array}\right\} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

The notion of this techniques is to descretize equations in accordance with behaviour of the substrate influence of the microbes, this is under the influence of structural deposition of the formation at various at lateritic soil, these conditions were found necessary since it's the microelement is subject of concern on the increase rate of enteromobacter in soil and water environments, so it is essential to ensure that the microelement is thoroughly investigated to monitor the rate of deposition at natural condition including activities of man various formation, thus predict their depositions at different depths in the study area.

$$\frac{Cs_5}{Ks_o + Cs}\frac{\partial Cs_5}{\partial t} + \frac{CA}{CA_o + CA}\frac{\partial Cs_5}{\partial z} = 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

$$\left.\begin{array}{l} t = 0 \\ z = 0 \\ Cs_{(o)} = 0 \\ \frac{\partial Cs_5}{\partial t}\Big| t = 0,\ B \end{array}\right\} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

$$\frac{Cs_6}{Ks_o + Cs_6}\frac{\partial Cs_6}{\partial t} - M_b\frac{\mu_o}{\gamma_o}\frac{\partial Cs_6}{\partial z} = 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

$$\left.\begin{array}{l} t = 0 \\ z = 0 \\ Cs_{(o)} = 0 \\ \frac{\partial Cs_6}{\partial t}\Big| t = 0,\ B \end{array}\right\} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

$$\frac{Cs_7}{Ks_o + Cs_7}\frac{\partial Cs_7}{\partial t} + q_z\,Cs_7\frac{\partial Cs_7}{\partial z} = 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (14)$$

$$\left.\begin{aligned} & t = 0 \\ & z = 0 \\ & Cs_{(o)} = 0 \\ & \frac{\partial Cs_7}{\partial t} \,\Big|\, t = 0,\ B \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (15)$$

$$\frac{Cs_8}{Ks_o + Cs_8}\,\frac{\partial Cs_8}{\partial t} + Ds\,\frac{\partial Cs_8}{\partial z} = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (16)$$

$$\left.\begin{aligned} & t = 0 \\ & z = 0 \\ & Cs_{(o)} = 0 \\ & \frac{\partial Cs_7}{\partial t} \,\Big|\, t = 0,\ B \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (17)$$

Applying direct integration on (2) we have

$$V\frac{\partial Cs}{\partial t} = q_z\, Cs + K_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (18)$$

Again, integrate equation (18) directly yield

$$VCs = qCs + K_1 t + K_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (19)$$

Subject to equation (3), we have

$$Cs_o = K_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (20)$$

And subjecting equation (19) to (3)

$$\text{At } \left.\frac{\partial Cs_1}{\partial t}\right|_{t = 0} = 0 \quad Cs_{(o)} = Cs_o$$

Yield

$$0 = VCs_o + K_2$$

$$\Rightarrow K_2 = -VC_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (21)$$

So that we put (20) and (210 into (19), we have

$$Vs_1 = VCs_1 t - q_z Cs_1 t + K_1 t + Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (22)$$

$$Cs_1 - V = Cs_o - q_z Cst \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (23)$$

$$\Rightarrow Cs_1\left[Cs_1 - Vt\right] = Cs_o\left[Cs_1 - q_z Cst\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (24)$$

$$\Rightarrow Cst = Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (25)$$

$$V \frac{\partial Cs_2}{\partial t} = D_s \frac{\partial Cs_2}{\partial z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

We approach this system using the Bernoulli's method of separation of variables.

i.e. $Cs_2 = ZT$ ……………… (26)

$$\frac{\partial Cs_2}{\partial t} = ZT^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (27)$$

$$\frac{\partial Cs_2}{\partial z} = Z^1 T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (28)$$

Put (27) and (28) into (26), so that we have

$$VZT^1 = qzCs\ Z^1 T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (29)$$

$$VZT^1 \frac{VT^1}{T} = qzCs \frac{Z^1}{Z} = -\lambda^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (30)$$

Hence $\frac{VT^1}{T} = -\lambda^2$ ……………… (31)

$$qzCs\, Z^1 + \lambda^2 Z = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (32)$$

From (32) $T = ACos \frac{\lambda t}{V} + B\ Sin \frac{\lambda z}{V}$ ……………… (33)

And (32) gives $T = \frac{-\lambda^2}{Cs\ell^{v}} t + B\ Sin \frac{\lambda z}{V}$ ……………… (34)

By substituting (32) and (33) into (26)

$$Cs_2 = \left[ACos \frac{\lambda}{\sqrt{V}} t + B\,Sin \frac{\lambda}{\sqrt{V}} x \right] Cs\ell^{\frac{-\lambda^2}{\sqrt{V}} t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (35)$$

$$Cs_o = Ac \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (36)$$

The expression from Equation (2) derived through linear integration of a quantity of parameters significant to the system, this is in accordance with the structural setting of the system, directed integration were found necessary to couple the variables they have similarity ,this is base on the deposition of the microelement reflecting the concentration of the enteromobacter from lateritic soil, it is confirmed that the concentration of carbon and enteromobacter experience high degree of concentration base on the structural deposited variation in the study location. Variables were found to express their relation with each other in terms of their pressure of increase including deposition of carbon increase in microbial population in organic soil, the accumulations of carbon are very high.

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Equation (35) becomes

$$Cs_2 = Cs_o \ell \frac{-\lambda^2}{Ds} t \ Cos \frac{\lambda}{V} x \qquad \text{.....................} (37)$$

Again at $\left. \frac{\partial Cs_2}{\partial t} \right| \begin{matrix} = 0, \ x = 0 \\ t = 0, \ B \end{matrix}$

Equation (37) becomes

$$\frac{\partial Cs_2}{\partial t} = \frac{\lambda}{V} Cs_o \ell^{\frac{-\lambda^2}{Ds} t} \ Sin \frac{\lambda}{V} x \qquad \text{.....................} (38)$$

$$\text{i.e. } 0 = \frac{\lambda}{\sqrt{V}} Sin \frac{\lambda}{V} 0 \qquad \text{.....................} \quad (39)$$

$Cs_o \frac{\lambda}{\sqrt{V}} \neq 0$ Considering NKP

$$0 = -Cs_o \frac{\lambda}{V} \ Sin \frac{\lambda}{V} B \qquad \text{.....................} (40)$$

$$\lambda = \frac{n\pi\sqrt{V}}{2} \qquad \text{.....................} (41)$$

So that equation (30) becomes

$$Cs_2 = Cs_o \ell^{\frac{-n^2\pi^2 V}{2Ds}} \ Cos \frac{n\pi\sqrt{V}}{2\sqrt{V}} x \qquad \text{.....................} (42)$$

$$Cs_2 = Cs_o \ell^{\frac{-n^2\pi^2 V}{2Ds}} \ Cos \frac{n\pi}{2} x \qquad \text{.....................} (43)$$

$$V \frac{\partial Cs_3}{\partial t} = Mb \frac{\mu_o}{\gamma_o} \frac{\partial Cs_3}{\partial z} \qquad \text{.....................} (6)$$

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

$$Cs_3 = ZT \qquad \text{.....................} (44)$$

$$\frac{\partial Cs_3}{\partial t} = ZT^1 \qquad \text{.....................} (45)$$

$$\frac{\partial Cs_3}{\partial z} = Z^1 T \qquad \text{.....................} (46)$$

Hence, we put (45) and (46) into (44), so that we have

$$V\frac{ZT^1}{T} = M_b \frac{\mu_o}{\gamma_o}\frac{Z^1 T}{T} \qquad \text{.....................} (47)$$

$$\text{i.e. } \frac{VT^1}{T} = M_b \frac{\mu_o}{\gamma_o}\frac{Z^1}{Z} - \lambda^2 \qquad \text{.....................} (48)$$

$$\text{Hence } V\frac{T^1}{T} + \lambda^2 = 0 \qquad \text{.....................} (49)$$

$$\text{i.e. } Z^1 + \frac{\lambda^2}{V}Z = 0 \qquad \text{.....................} (50)$$

$$\text{And } M_b \frac{\mu_o}{\gamma_o} T^1 + \lambda^2 T = 0 \qquad \text{.....................} (51)$$

$$\text{From (50) } X = ACos\frac{\lambda}{V}Z + BSin\frac{\lambda}{V}Z \qquad \text{.....................} (52)$$

And (45) gives

$$T = Cs_o \ell^{\frac{-\lambda^2}{M_b \frac{\mu_o}{\gamma_o}}t} \qquad \text{.....................} (53)$$

By substituting (52) and (53) into (44), we get

$$Cs_3 = \left[ACos\frac{\lambda}{V}Z + BSin\frac{\lambda}{\sqrt{V}}Z\right]Cos\ell^{\frac{-\lambda^2}{M_b \frac{\mu_o}{\gamma_o}}t} \qquad \text{.....................} (54)$$

Subject (54) to condition in (6) so that we have

$$Cs_o = Ac \qquad \text{.....................} (55)$$

comparable situation are expressed in equation (55) the depositions of carbon migrating to lateritic soil are establish to deposit very high concentration of microelements, due the low permeability content, therefore the propensity of accumulation waiting for high degree of saturation is to enable it migrate to were the permeability deposit higher degree in the soil strata, similar condition developed the composition of these parameter integration in equation (55) were the concentration of the substrate at the state experiences variations, condition, so the formation stratum determined the expressed variable that developed model denoted as C_s = Ac in equation (55).

Equation (56) becomes

$$Cs_3 = Cs_o \ell \frac{-\lambda^2}{M_b \frac{\mu_o}{\gamma_o}} t \ Cos \frac{\lambda}{V} Z \qquad \text{..................... (56)}$$

Again at $\frac{\partial Cs_3}{\partial t} \Big| \quad t = 0, \ B$

Equation (58) becomes

$$\frac{\partial Cs_2}{\partial t} = \frac{\lambda}{\sqrt{V}} Cos \ell^{\frac{-\lambda^2}{M_b \frac{\mu_o}{\gamma_o}} t} \quad Sin \frac{\lambda}{V} x \qquad \text{..................... (57)}$$

i.e. $0 = -Cs_o \frac{\lambda}{\sqrt{V}} \ Sin \frac{\lambda}{V} 0$

$Cs_o \frac{\lambda}{\sqrt{V}} \neq 0$ Considering NKP

Equation (40) and (57) showcase the pressure of the microelements in terms of enhance in microbial population, this situation were considered in these various in these two equations, microbial population expressed is to monitor the formations were microbes are predominant. The equations take care of the rate of carbon deposition in the formations, the equation in (40) and (55) expressed the results of high degree of deposition in the formations, the above expressed equation reflect the consequences of carbon deposition, the expression is to monitor microbial population, including high degrees of feeding from the substrate deposition in the formations. This condition generates lots of variations in microbial behaviour in different dimensions. Mores the degree of substrate considered in the state of microbial transport determined the rate of inhibition from other influence that deposit in soil and water environment.

$$0 = -Cs_o \frac{\lambda}{V} \ Sin \frac{\lambda}{V} B \qquad \text{..................... (58)}$$

$$\Rightarrow \frac{\lambda}{\sqrt{V}} = \frac{n\pi\sqrt{V}}{2} \qquad \text{..................... (59)}$$

$$\Rightarrow \lambda = \frac{n\pi\sqrt{V}}{2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (60)$$

So that equation (61)

$$Cs_3 = Cs_o \ell^{\frac{-n^2\pi^2 V}{2M_b \frac{\mu_o}{\gamma_o}}} Cos \frac{n\pi\sqrt{V}}{2\sqrt{V}} Z \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (61)$$

$$\Rightarrow Cs_3 = Cs_o \ell^{\frac{-n^2\pi^2 V}{2M_b \frac{\mu_o}{\gamma_o}}} t\, Cos \frac{n\pi}{2} Z \qquad \ldots\ldots\ldots\ldots\ldots\ldots (62)$$

Now we consider equation (8)

$$V \frac{\partial Cs_4}{\partial t} = \frac{CA}{KA+CA} \frac{\partial Cs_4}{\partial z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Using Bernoulli's method of separation of variables, we have

$$Cs_4 = ZT \qquad \ldots\ldots\ldots\ldots\ldots\ldots (63)$$

$$\frac{\partial Cs_4}{\partial t} = ZT^1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots (64)$$

$$\frac{\partial Cs_4}{\partial Z} = Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots (65)$$

$$VZT = -\frac{CA}{KA+CA} Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots (66)$$

i.e. $$\frac{VT^1}{T} = \frac{CA}{KA+CA} \frac{Z^1}{Z} = \varphi \qquad \ldots\ldots\ldots\ldots\ldots\ldots (67)$$

$$\frac{VT^1}{T} = \varphi \qquad \ldots\ldots\ldots\ldots\ldots\ldots (68)$$

$$\frac{CA}{KA+CA} \frac{Z^1}{Z} = \varphi \qquad \ldots\ldots\ldots\ldots\ldots\ldots (69)$$

And $$Z = B\ell \frac{\varphi}{\frac{CA}{KA+CA}} Z \qquad \ldots\ldots\ldots\ldots\ldots\ldots (70)$$

Put (68) and (69) into (63), gives

$$Cs_4 = A\ell \frac{\varphi}{\frac{CA}{KA+CA}} Z \quad B\ell \frac{\varphi}{\frac{CA}{KA+CA}} t \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (71)$$

$$Cs_4 = AB\ell^{(x-t)} \frac{\varphi}{\frac{CA}{KA+CA}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (72)$$

Subject equation (69) to (8) yield

$$Cs_4 = (o) = C_o \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (73)$$

So that equation (73) becomes

$$Cs_4 = Cs_o \ell^{(x-t)} \frac{V}{\frac{CA}{KA+CA}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (74)$$

Now, we consider equation (10)

$$\frac{Cs_5}{Ks_o + Cs} \frac{\partial Cs_5}{\partial t} + \frac{CA}{CA_o + CA} \frac{\partial Cs_5}{\partial z} = 0 \quad \ldots\ldots\ldots\ldots \quad (10)$$

Apply Bernoulli's method, we have

$$Cs_5 = ZT \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (75)$$

$$\frac{\partial Cs_5}{\partial t} = ZT^1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (76)$$

$$\frac{\partial Cs_5}{\partial Z} = Z^1T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (77)$$

Put (75) and (76) into (10), so that we have

$$\frac{Cs}{Ks_o + Cs} ZT^1 = -Z^1T \frac{CA}{CA_o + CA} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (78)$$

i.e. $$\frac{Cs}{Ks_o + Cs} \frac{T^1}{T} = \frac{Z^1}{Z} \frac{CA}{CA_o + CA} = \varphi \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (79)$$

$$\frac{Cs}{Ks_o + CA} \frac{T^1}{T} = \varphi \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (80)$$

$$\frac{CA}{CA_o + CA} \frac{Z^1}{Z} = \varphi \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (81)$$

$$T = \frac{\phi}{\frac{Cs}{Ks_o + CA}} t \qquad \text{.................} \qquad (82)$$

And $$Z = B\ell \frac{-\phi}{\frac{CA}{CA_o + CA}} Z \qquad \text{.................} \qquad (83)$$

Put (80) and (81) into (73), gives

$$Cs_5 = A \frac{\phi}{\frac{CA}{CA_o + CA}} t \;\; B \frac{-\phi}{\frac{CA}{CA_o + CA}} t \qquad \text{.................} \qquad (84)$$

$$Cs_5 = AB\ell^{(x-t)} \frac{\phi}{\frac{CA}{CA_o + CA}} \qquad \text{.................} \qquad (85)$$

Subject equation (83) and (84) into (74) yield

$$Cs_5 = (o) = Cs_o \qquad \text{.................} \qquad (86)$$

So that equation (84) and (85) becomes

$$Cs_5 = (o) = Cs_o \;\; \ell^{(x-t)} \frac{\phi}{\frac{CA}{CA_o + CA}} \qquad \text{.................} \qquad (87)$$

Now, we consider equation (12)

$$\frac{Cs_6}{Ks_o + Cs_6} \frac{\partial Cs_6}{\partial t} - M_b \frac{\mu_o}{\gamma_o} \frac{\partial Cs_6}{\partial z} = 0 \qquad \text{...........} \qquad (12)$$

Applying Bernoulli's method of separation of variables, we have

$$Cs_6 = ZT \qquad \text{.................} \qquad (88)$$

$$\frac{\partial Cs_6}{\partial t} = ZT^1 \qquad \text{.................} \qquad (89)$$

$$\frac{\partial Cs_6}{\partial Z} = Z^1 T \qquad \text{.................} \qquad (90)$$

$$ZT \frac{Cs_6}{Ks_o + Cs_6} - M_b \frac{\mu_o}{\gamma_o} Z^1 T \qquad \text{.................} \qquad (91)$$

i.e. $$\frac{Cs_6}{Ks_o + Cs_6} \frac{T^1}{T} = M_b \frac{\mu_o}{\gamma_o} \frac{Z^1}{Z} \qquad \text{.................} \qquad (92)$$

$$\frac{Cs_6}{Ks_o + Cs_6}\frac{T^1}{T} = \alpha \qquad \text{.................} \qquad (93)$$

$$M_b \frac{\mu_o}{\gamma_o}\frac{Z^1}{Z} = \alpha \qquad \text{.................} \qquad (94)$$

And $Z = B\ell \dfrac{\alpha}{Ks_o + Cs} Z$ .... (95)

Put (94) and (95) into (88) gives

$$Cs_6 = A\ell^{\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}}t} \quad B\ell^{\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}}t} \qquad \text{.................} \qquad (96)$$

$$Cs_6 = AB\ell^{(x-t)} M_b \frac{\mu_o}{\gamma_o} \qquad \text{.................} \qquad (97)$$

Subject equation (95) and (96) into (97) yield

$$Cs_6 = (o) = Cs_o \qquad \text{.................} \qquad (98)$$

So that equation (95 and (98) becomes

$$Cs_6 = Cs_o\, \ell^{(t-x)\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}}} \qquad \text{.................} \qquad (99)$$

$$\frac{Cs_7}{Ks_o + Cs_7}\frac{\partial Cs_7}{\partial t} + qzCs\frac{\partial Cs_7}{\partial z} = 0 \qquad \text{...........} \qquad (7)$$

$$Cs_7 = ZT \qquad \text{.................} \qquad (100)$$

$$\frac{\partial Cs_7}{\partial t} = ZT^1 \qquad \text{.................} \qquad (101)$$

$$\frac{\partial Cs_7}{\partial Z} = Z^1 T \qquad \text{.................} \qquad (102)$$

Put (100) and (101) into (14), so that we have

$$ZT^1 \frac{Cs}{Ks_o + Cs} = Z^1 T\, qzCs \qquad \text{.................} \qquad (103)$$

i.e. $\dfrac{Cs}{Ks_o + Cs}\dfrac{T^1}{T} = \dfrac{Z^1}{Z} qzCs$ .... (104)

$$\frac{Cs}{Ks_o + Cs}\frac{T^1}{T} = \rho \qquad \text{.................} \qquad (105)$$

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$$qzCs\ \frac{Z^{1}}{T} = \rho \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (106)$$

$$T = A\frac{\rho}{\frac{Cs}{Ks_{o} + Cs}}t \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (107)$$

And $Z = B\ell^{\frac{-\rho}{qzCs}Z}$ …………… (108)

Put (106) and (107) into (100), gives

$$Cs_{7} = A\ell^{\frac{\rho}{qzCs}t}\ B\ell^{\frac{\rho}{qzCs}Z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (109)$$

$$Cs_{7} = AB\ell^{-(x-t)}\frac{\rho}{qzCs} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (110)$$

Subject equation (107) and (109) into (100) yield

$$Cs_{7} = (o) = Cs_{o} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (111)$$

So that equation (109) and (110) becomes

$$Cs_{7} = A\ell^{\frac{\rho}{qzCs}t}\ B\ell^{\frac{\rho}{qzCs}Z} \qquad \ldots\ldots\ldots\ldots\ldots \qquad (112)$$

Now, we consider equation (16) which is the steady plow rate of the system

$$\frac{Cs_{8}}{Ks_{o} + Cs_{8}}\frac{\partial Cs_{8}}{\partial t} + Ds\frac{\partial Cs_{8}}{\partial z} = 0 \ \ldots\ldots\ldots\ldots \qquad (16)$$

Applying Bernoulli's method, we have

$$Cs_{8} = ZT \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (113)$$

$$\frac{\partial Cs_{8}}{\partial t} = ZT^{1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (114)$$

$$\frac{\partial Cs_{8}}{\partial Z} = Z^{1}T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (115)$$

Put (113) and (114) into (16), so that we have

$$\frac{Cs_{6}}{Ks_{o} + Cs_{6}}ZT^{1} = Ds\,Z^{1}T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (116)$$

i.e. $\frac{Cs}{Ks_{o} + Cs}\frac{T^{1}}{T} = Ds\frac{Z^{1}}{Z}$ ……………… (117)

$$\frac{Cs}{Ks_{o} + Cs}\frac{T^{1}}{T} = \theta \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (118)$$

$$Ds\frac{Z^{1}}{Z} = \theta \qquad \text{.................} \qquad (119)$$

$$Z = A\frac{\frac{\theta}{Cs}}{Ks_{o} + Cs}Z \qquad \text{.................} \qquad (120)$$

And $T = B\frac{\theta}{Ds}t$ .... (121)

Put (119) and (121) into (113), gives

$$Cs_{8} = A\frac{\frac{\theta}{Cs}}{Ks_{o} + Cs}B\ell^{\frac{\theta}{Ds}} \qquad \text{.................} \qquad (122)$$

$$Cs_{8} = AB\ell^{(t-x)}\frac{\theta}{Ds} \qquad \text{.................} \qquad (123)$$

Subject to equation (122) and (123) yield

$$Cs_{8} = (o) = Cs_{o} \qquad \text{.................} \qquad (124)$$

So that equation (123) become

$$Cs_{8} = Cs_{o}\ell^{(t-x)}\frac{\theta}{Ds} \qquad \text{.................} \qquad (125)$$

The development of Steady state were considered in this condition as expressed in equation (125), the deposition of microelements were articulated beneath the influences of formation dissimilarity in deposition of the strata. But in most circumstance where the formation experienced homogeneous deposition at the same time carbon maintained consistency concentration in deposition, it means that in pin lateritic soil as batch system application, there the tendency of uniform flow of the microelements and enteromobacter concentration in lateritic soil formation, therefore such condition may result to consistent flow and concentration from the microelement and enteromobacter concentration, so equation (125) showcase such condition in the system, this reflect the behaviour assumed in the migration of the contaminant and the deposition of carbon in the study location.

Now, assuming that at the steady flow, there is no NKP for substrate utilization, our concentration is zero, so that equation (124) becomes

$$Cs_{8} = 0 \qquad \text{.................} \qquad (126)$$

The expressed condition in the system of equation (126) were able to deem the condition of microelements, whereby it may not be experienced in the strata, these conditions are possible in the sense that some formations of microelements may experienced some reaction with some minerals in natural origin in the formation, thus the concentration may be inhibited developing zero, it implies that there is no deposition of substrate due to reaction developing inhibition in those formation as expressed in equation (126)

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Therefore, solution of the system is of the form

$$Cs = Cs_1 + Cs_2 + Cs_3 + Cs_4 + Cs_5 + Cs_6 + Cs_7 + Cs_8 \quad \ldots\ldots\ldots\ldots\ldots \qquad (127)$$

We now substitute (25), (43), (62), (74), (87), (99), (112) and (125) into (128), so that we have the model of the form

$$Cs = Cs_o + Cs_o\ \ell^{\frac{-n^2\pi^2 V}{2Ds}} Cos\frac{n\pi}{2}Z + Cs_o\ \ell^{\frac{-n^2\pi^2 V}{2M_b\frac{\mu_o}{\gamma_o}}}\ Cos\frac{\sqrt{V}}{2\sqrt{V}}Z$$

$$+\ C_o\ \ell^{(t-x)}\frac{V}{\frac{CA}{KA+CA}} + Cs_o\ \ell^{(t-x)}\frac{\phi}{\frac{CA}{CA_o+CA}} + Cs_o\ \ell^{(t-x)}\frac{\varphi}{M_b\frac{\mu_o}{\gamma_o}} +$$

$$Cs_o\ell^{(t-x)}\frac{\rho}{qzCs} + Cs_o\ell^{(t-x)}\frac{\theta}{Ds} \quad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (128)$$

$$\Rightarrow Cs = Cs_o\ 1 + \ell^{\frac{-n^2\pi^2 V}{2Ds}} Cos\frac{n\pi}{2}Z + \ell^{\frac{-n^2\pi^2 V}{2M_b\frac{\mu_o}{\gamma_o}}}\ Cos\frac{n\pi}{2} +$$

(129

$$C_o\ \ell^{(t-x)}\frac{V}{\frac{CA}{KA+CA}} + \ell^{(t-x)}\frac{\phi}{\frac{CA}{CA_o+CA}} + \ell^{(t-x)}\frac{\varphi}{M_b\frac{\mu_o}{\gamma_o}} + \ell^{(t-x)}\frac{\rho}{qzCs} + \ell^{(t-x)}\frac{\theta}{Ds}$$

The derived solution model in (129) is from the established governing equation that considered numerous situations that could pressure the deposition of carbon in lateritic soil formation. The deposition of carbon were evaluated thoroughly from different situation in the study location, these procedure were itemizes, in modifying the developed governing equation, numerous circumstances that influence the behaviour of carbon deposition were also expressed in the system, since carbon are microelement that will definitely increase enteromobacter growth thus determined the inhabitants of the microorganism in soil and water environments, these state were streamlined in the resultant model at various phase, the behaviour of microelement carbon deposition express the concentration variables denoted mathematically in the system, this state were determined through the limit values as express in the model equation, different stage were expressed on the procedure of developing the model denoting it through various mathematical tools, from assorted characteristics of the formations, the rate of concentration of the substrate determined the rate of concentration of the enteromobacter under normal circumstance, such condition where the deposition are very high and there is degradation of the microorganisms that are also considered in the system. this was expressed on the derived mathematical expression. The model if applied will definitely monitored and determine the deposition and growth rate of enteromobacter in lateritic soil within a region of the formation.

4. Conclusion

The deposition of microelement carbon in our environment has defined to deposit high accumulation in lateritic soil formation; this state of the soil sample condition may be manmade activities and natural origin. Microelement deposition in the study location increase the natural origin are from made activities, the rates of concentration in lateritic soil formation area were confirmed to be very high, and the evaluation from risk assessment express carbon to be at high percent. This level of deposition are reflected on the high deposition of enteromobacter in the study area, the migration of enteromobacter in soil and water varied, these expression were observe from risk evaluation, more so, the condition were reflected from the geomorphology and geochemistry deposition of soil strata, enteromobacter predominantly deposited, this condition implies that high deposition of carbon has increase the concentration of the microbes from lateritic soil in the study area, the derived mathematical models developed will definitely maintained the prevention of pollution and determine the concentration of carbon in lateritic soil in other stop further migration.

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