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Research article

MODELING POTASSIUM AND LEAD DEPOSITION INFLUENCED BY POROSITY AND DISPERSION IN HOMOGENEOUS FINE AND GRAVEL FORMATION IN SEMI CONFINE BED AT OKIRIKA, RIVERS STATE OF NIGERIA

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Abstract

Potassium and lead are deposited in fine sand and gravel formation in Okirika, these examination were confirm through hydrogeological and desk studies carried out to examine the rate of physiochemical reaction at various homogeneous strata. The deposited fine sand and gravel formation in the study location are predominantly homogeneous formation, but few location deposited slight heterogeneous strata, it was also revealed that semi confined bed experienced over burden pressure in the formation. porosity deposited high percentage; these were reflected on the rate of dispersions influences of potassium and lead deposition, the physiochemical interaction from potassium and lead were thoroughly assessed in the study location, these expressed parameters that established lots of pressured which is reflected on potassium and lead migration process in soil and water environments. Base on these factors mathematical modeling techniques were found suitable to express various rate of deposition and migration of potassium and lead in the study location. The derived model from the governing equation were approached by various mathematical methods, the derived solution considered different dimension that has cause lots solute movement to semi confined bed before developing the derived equation to produces the model in the study area.

Keywords: modeling potassium, lead, porosity, find and gravel sand formation.

Introduction

Plant litter is one of the basis of generating primary nutrient saprophytic microbiota in soils, and its amount and properties strongly pressure the formation and humification of soil organic matter (SOM) in terrestrial ecosystems (Swift et al. 1979; Scholes et al. 1997; Kögel-Knabner 2002). Soil microbial biomass represents a significant compartment of terrestrial carbon, and its residues are important parent materials for humus formation (Haider 1992; Kögel-Knabner 2002 Eluozo 2013).Growth of the microorganisms responsible for genesis and cycling of humic substances is influenced by carbon (C) and nitrogen (N) availability in the decomposing plant residues (Balser 2005). During plant residue decomposition, a fraction of the plant C and N is assimilated into the microbial biomass, rendering it largely inaccessible to further biological transformation. The assimilated C and N may remain unavailable to the plant and decomposer community for an appreciable time after microbial death (Jansson and Persson 1982). Little is known, however, about the fate of the C and N in the dead microbial cells. Soil amino sugars are predominantly of microbial origin (Parsons 1981; Stevenson 1982) and are relatively stable over time (Chantigny et al. 1997). The relative representation of different structural classes of amino sugars can be used to differentiate between fungal and bacterial residues in soils (Guggenberger et al. 1999; Glaser et al. 2004).understanding the fungal and bacterial contributions to microbial residues can further provide insights into how these organisms govern C and N cycling in soil (Amelung 2001; Simpson et al. 2004 Eluozo, 2013). The approach is based on existence of several distinct variations on the molecular structure of amino sugars, with two of them representative of bacteria and one of fungi (Nannipieri et al. 1979; Parsons 1981). Amino sugars are rapidly synthesized during microbial immobilization of inorganic N (McGill et al. 1973), regardless of the type of organic material added to soil (Sowden 1968). Lowe (1973) found that the amino sugar content of forest soils increases with respect to humification. Dai et al. (2002) showed that the level of amino sugar N, as a proportion of total N, remains constant or increases with time in arctic soil microcosms. Amelung et al. (2001) used amino sugars to investigate the fate of microbial residues during beech leaf (Fagus sylvatica L.) litter decomposition; however, their experiment was confined only to pure minerals and plant litters (not real soil). Little is known about the time scale at which amino sugars respond to introduced plant materials in soils.

2. Theoretical background

Semi confined beds are formations that are deposited in okirika, Rivers State of Nigeria. The strata structures develop semi confine through minor overburden pressures deposited in homogenous fine and gravel formation. The stratification setting deposits slight overburden pressure under the influence of alluvium deposition predominated known to develop its strata structure by sea deposition. Such geological origins were always known to deposit homogeneous structure even if it is lies under Benin formation. Discovering slight overburden pressure that structures homogeneous in some region of Okirika settlements it was confirmed from hydrogeological studies to deposit homogeneous fine and gravel sand overburden by deltaic clay. These were influenced by high degree of porosity that established an interaction with dispersion rate under the influence of the micropores of deposited strata. Potassium and lead were found to deposit semi confined beds from deposited fine and gravel sand. Such physiochemical depositions were found to establish a reaction. These circumstances subject the deposition of potassium to establish a fluctuation of inhibition by lead. Subject to this interaction, the established reactions between the two parameters leads to fluctuation in the water quality of semi confined beds. Dispersion influence was found to deposit through high percentage of porosity in the strata dispersing potassium and lead in semi confined beds. These have generated high spread of the pollutants in some regions where semi confined beds are deposited. Subject to these challenges, better solutions to prevent further migration or dispersion of this contaminant should be developed. In line with these factors, mathematical model were found appropriate to express dissimilar influences and ways of preventing such contamination. These factors are considered where a system that captured every parameters were recorded, these circumstances was considered and it generate the governing equations stated below.

3. Governing equation

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

The developed governing equations were designed from the system that measured all the factors in the study. This is by expressing the deposition of potassium and lead in semi confined beds. Geological influence of alluvium deposition was found predominant with homogeneous fine and gravel formation in semi confined beds. More so, potassium and lead were found to deposit in homogeneous fine sand of semi confined aquiferous zone. These factors were expressed in developing governing equation stated above.

$$V\frac{\partial Cs_1}{\partial t} = M_b \frac{\mu_o}{\gamma_o}\frac{\partial Cs_1}{\partial z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

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

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

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

$$V\frac{\partial Cs_3}{\partial t} = \frac{\partial Cs_3}{\partial t}\frac{Cs_o}{K_{so}+C_o} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

$$\left.\begin{array}{l} t = 0 \\ Cs_{(o)} = 0 \\ \frac{\partial Cs_3}{\partial t}\,\Big|\, t = 0,\ B \end{array}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

$$V\frac{\partial Cs_4}{\partial t} = D_s\frac{\partial Cs_4}{\partial z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

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

$$V\frac{\partial Cs_5}{\partial t} + \frac{\partial Cs_5}{\partial z}q_z\,Cs \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

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

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

$$\left.\begin{array}{l} x = 0 \\ Cs_{(o)} = 0 \end{array}\right\} \quad \ldots\ldots\ldots\ldots\ldots \quad (13)$$

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

Applying direct integration on (2)

$$\frac{\partial Cs_1}{\partial t} = M_b \frac{\mu_o}{\gamma_o} + K_1 \quad \ldots\ldots \quad (14)$$

Again, integrate equation (14) directly yield

$$VCs = M_b \frac{\mu_o}{\gamma_o} + K_1 + K_2 \quad \ldots\ldots\ldots\ldots\ldots \quad (15)$$

Subject to equation (3) we have

$$Cs_{(o)} = K_2 \quad \ldots\ldots\ldots\ldots \quad (16)$$

Subjecting equation (15) to (3)

$$\text{At } \frac{\partial Cs_1}{\partial t}\Bigg| \begin{matrix} = 0 \;\; Cs_{(o)} = Cs_o \\ t = 0 \end{matrix}$$

Yield

$$O = VCs_o = K_2$$

$$K_2 = VC_o \quad \ldots\ldots\ldots\ldots\ldots \quad (17)$$

So that we put (16) and (17) into (15), we have

$$Cs_1 = VCs_1 t - M_b \frac{\mu_o}{\gamma_o} Cst + Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (18)$$

$$Cs_1 = V = Cs_o - M_b \frac{\mu_o}{\gamma_o} Cst \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (19)$$

$$\Rightarrow Cs_1 \left[Cs_1 - Vt\right] = Cs_o \left[Cs_1 - M_b \frac{\mu_o}{\gamma_o}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (20)$$

$$\Rightarrow Cst = Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (21)$$

$$V \frac{\partial Cs_2}{\partial t} = \frac{\partial Cs_2}{\partial z} \frac{C_A}{K_{Ao} + C_A} \quad \ldots\ldots\ldots \quad (4)$$

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

i.e. $Cs_2 = ZT$ ……………… (22)

$$\frac{\partial Cs_2}{\partial t} = ZT^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (23)$$

$$\frac{\partial Cs_2}{\partial z} = Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (24)$$

Put (23) and (24) into (25), so that we have

$$VZT^1 = \frac{C_A}{K_{Ao} + C_A} Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (25)$$

$$VZT^1 \frac{VT^1}{T} = \frac{C_A}{K_{Ao} + C_A} \frac{Z^1}{Z} = -\lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (26)$$

Hence $\frac{VT^1}{T} = -\lambda^2$ ………………… (27)

$$\frac{C_A}{K_{Ao} + C_A} Z^1 + \lambda^2 Z = 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (28)$$

From (27) $T = ACos\frac{\lambda}{V}t + B\ Sin\frac{\lambda}{V}z$ ………………… (29)

And (28) gives $T = Cs\ell^{\frac{-\lambda^2}{V}t}$ ………………… (30)

By substituting (28) and (29) into (22) we get

$$Cs_2 \left[ACos\frac{\lambda}{\sqrt{V}}t + B\,Sin\frac{\lambda}{\sqrt{V}}z \right] Cs\ell^{\frac{-\lambda^2}{\sqrt{V}}t} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (31)$$

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

Equation (31) becomes

$$Cs_2 = Cs_o \ell^{\frac{-\lambda^2}{\frac{C_A}{K_{Ao} + C_A}}t} \ Cos\frac{\lambda}{V}z \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (33)$$

Again at $\frac{\partial Cs_2}{\partial t}\bigg| \begin{matrix} = 0, z = 0 \\ t = 0, B \end{matrix}$

Equation (33) becomes

$$\frac{\partial Cs_2}{\partial t} = \frac{\lambda}{V} Cs_o \ell^{\frac{-\lambda^2}{\frac{C_A}{K_{Ao} + C_A}}t} \ Sin\frac{\lambda}{V}z \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (34)$$

i.e. $0 = Cs_o \frac{\lambda}{\sqrt{V}}\ Sin\frac{\lambda}{V}0$ ………………… (35)

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

$$0 = -Cs_o \frac{\lambda}{V} Sin \frac{\lambda}{V} B \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (36)$$

$$\Rightarrow \lambda = \frac{n\pi\sqrt{V}}{2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (37)$$

So that equation (33) becomes

$$Cs_2 = Cs_o \, \ell^{\frac{\frac{-n^2\pi^2 V}{C_A}}{2\frac{}{K_{Ao} + C_A}}} Cos \frac{n\pi\sqrt{V}}{2\sqrt{V}} z \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (38)$$

$$Cs_2 = Cs_o \, \ell^{\frac{\frac{-n^2\pi^2 V}{C_A}}{2\frac{}{K_{Ao} + C_A}}} Cos \frac{n\pi}{2} z \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (39)$$

We consider equation (6)

$$V \frac{\partial Cs_3}{\partial t} = \frac{\partial Cs_3}{\partial z} \frac{Cs}{Ks_o + Cs} \qquad \ldots\ldots\ldots \quad (6)$$

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

$$Cs_3 = ZT \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (40)$$

$$\frac{\partial Cs_3}{\partial t} = ZT^1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (41)$$

$$\frac{\partial Cs_3}{\partial z} = Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (42)$$

Again, we put (41) and (42) into (40), so that we have

$$VZT^1 = \frac{Cs}{Ks_o + Cs_3} Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (43)$$

$$\text{i.e. } \frac{VT^1}{T} = \frac{Cs}{Ks_o + Cs_3} \frac{Z^1}{Z} - \lambda^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (44)$$

Hence $\frac{VT^1}{T} = -\lambda^2$ ………………… (45)

i.e. $\frac{Cs}{Ks_o + Cs} Z^1 + \lambda^2 z = 0$ ………………… (46)

From (46) $T = ACos\frac{\lambda t}{V} Z + BSin\frac{\lambda z}{V}$ ………………… (47)

And (46) gives

$$T = Cs_o \ell^{\frac{-\lambda^2}{V}t} \qquad \text{………………… (48)}$$

By substituting (47) and (48) into (40), we get

$$Cs_3 = \left[ACos\frac{\lambda}{V} z + B\,Sin\frac{\lambda}{\sqrt{V}} z \right] Cs\ell^{\frac{-\lambda^2}{V}t} \qquad \text{………………… (49)}$$

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

$$Cs_o = Ac \qquad \text{………………… (50)}$$

$$Cs_3 = Cs_o \ell \frac{-\lambda^2}{V} t \; Cos\frac{\lambda}{\sqrt{V}} Z \qquad \text{………………… (51)}$$

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

Equation (51) becomes

$$\frac{\partial Cs_2}{\partial t} = \frac{\lambda}{\sqrt{V}} Cs_o \ell^{\frac{-\lambda^2}{\frac{Cs}{Ks_o + Cs}}} \; Sin\frac{\lambda}{V} z \qquad \text{………………… (52)}$$

i.e. $0 = -Cs_o \frac{\lambda}{\sqrt{V}} \; Sin\frac{\lambda}{V} 0$ ………………… (53)

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

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

$$0 = -Cs_o \frac{\lambda}{V} \; Sin\frac{\lambda}{V} B \qquad \text{………………… (54)}$$

$$\Rightarrow \frac{\lambda}{\sqrt{V}} = \frac{n\pi}{2} \qquad \text{………………… (55)}$$

$$\Rightarrow \lambda = \frac{n\pi\sqrt{V}}{2} \quad \ldots\ldots\ldots\ldots\ldots (56)$$

So that equation (57)

$$Cs_3 = Cs_o\, \ell^{\frac{\frac{-n^2\pi^2 V}{C_A}}{2\frac{}{K_{Ao} + C_A}}}\, Cos \frac{n\pi\sqrt{V}}{2\sqrt{V}} z \quad \ldots\ldots\ldots\ldots\ldots (57)$$

$$\Rightarrow Cs_3 = Cs_o\, \ell^{\frac{-n^2\pi^2 V}{2V}t}\, Cos \frac{n\pi}{2} z \quad \ldots\ldots\ldots\ldots\ldots (58)$$

The formation of Benin defines the strata setting under the influence of porosity and dispersion of potassium and lead. Substrate was considered in the system to be predominant in some regions of the strata where an inhibition from lead may experience inactivity. Such conditions expressed the tendency of pollutant growth rate deposited in every stratum of the formation. Based on these factors, substrate utilization were considered in the system through the modified governing equation expressed on the process of the derived solution as stated in equation (58) above

Now we consider equation (8)

$$V \frac{\partial Cs_4}{\partial t} = Ds \frac{\partial Cs_4}{\partial z} \quad \ldots\ldots\ldots \quad (8)$$

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

$$Cs_4 = ZT \quad \ldots\ldots\ldots\ldots \quad (59)$$

$$\frac{\partial Cs_4}{\partial t} = ZT^1 \quad \ldots\ldots\ldots\ldots \quad (60)$$

$$\frac{\partial Cs_4}{\partial Z} = Z^1 T \quad \ldots\ldots\ldots\ldots \quad (61)$$

Put (60) and (61) into (8), so that we have

$$VZT^1 = -DsZ^1T \quad \ldots\ldots\ldots\ldots \quad (62)$$

i.e. $$\frac{VT^1}{T} = Ds\frac{Z^1}{Z} = \varphi \quad \ldots\ldots\ldots\ldots \quad (63)$$

$$Ds\frac{Z^1}{Z} = \varphi \quad \ldots\ldots\ldots\ldots \quad (64)$$

$$T = A\frac{\varphi}{V} z \quad \ldots\ldots\ldots\ldots \quad (65)$$

$$Z = B\ell^{\frac{-\varphi}{V}z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (66)$$

And

Put (65) and (60) into (59), gives

$$Cs_4 = A\ell^{\frac{\varphi}{Ds}z} \bullet B\ell^{\frac{-\varphi}{Ds}z} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (67)$$

$$Cs_4 = AB\ell^{(x-t)}\frac{\varphi}{Ds} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (68)$$

Subject equation (67) to (8) yield

$$Cs_4 = (o) = C_o \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (69)$$

So that equation (69) becomes

$$Cs_4 = Cs_o\ell^{(x-t)}\frac{\varphi}{Ds} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (70)$$

Now, we consider equation (9)

$$V\frac{\partial Cs_5}{\partial t} = \frac{\partial Cs_5}{\partial z}q_z C_s \quad \ldots\ldots\ldots\ldots \qquad (9)$$

Apply Bernoulli's method, we have

$$Cs_5 = ZT \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (71)$$

$$\frac{\partial Cs_5}{\partial t} = ZT^1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (72)$$

$$\frac{\partial Cs_5}{\partial Z} = Z^1 T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (73)$$

Put (72) and (73) into (9), so that we get

$$VXT^1 = -Z^1 T q_z C_s \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (74)$$

i.e. $$\frac{VT^1}{T} = \frac{Z^1}{Z}q_z C_s = \phi \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (75)$$

$$\frac{VT^1}{T} = \phi \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (76)$$

$$\frac{Z^1}{Z} = \phi \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (77)$$

$$T = \frac{A\phi}{V}T \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (78)$$

$$Z = B\ell\frac{-\phi}{q_z C_s}Z \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (79)$$

And

Put (78) and (79) into (71), gives

$$Cs_5 = A\ell^{\frac{\phi}{q_z C_s}t} \bullet B\ell^{\frac{-\phi}{q_z C_s}t} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (80)$$

$$Cs_5 = AB\ell^{(x-t)}\frac{\phi}{q_z C_s} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (81)$$

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

$$Cs_5 = (o) = Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (82)$$

So that equation (81) and (82) becomes

$$Cs_5 = (o) = Cs_o\ \ell^{(t-x)}\frac{\phi}{q_z C_s} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (83)$$

Now, we consider equation (11) which is the steady flow rate of the system

$$M_b \frac{\mu_o}{\gamma_o}\frac{\partial Cs_6}{\partial z} = \frac{\partial Cs_6}{\partial z}\frac{C_A}{K_{Ao} + C_A} \quad \ldots\ldots. \quad (11)$$

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

$$Cs_6 = ZT \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (84)$$

$$\frac{\partial Cs_6}{\partial t} = ZT^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (85)$$

$$\frac{\partial Cs_6}{\partial Z} = Z^1T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (86)$$

Put (85) and (86) into (11), so that we have

$$M_b \frac{\mu_o}{\gamma_o} Z^1T = -\frac{C_A}{K_{Ao} + C_A} Z^1T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (87)$$

i.e. $M_b \frac{\mu_o}{\gamma_o}\frac{Z^1}{Z} = \frac{C_A}{K_{Ao} + C_A}\frac{Z^1}{Z} = \alpha$ ……………… (88)

$$M_b \frac{\mu_o}{\gamma_o}\frac{Z^1}{Z} = \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (89)$$

$$\frac{C_A}{K_{Ao} + C_A}\frac{Z^1}{Z} = \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (90)$$

$$Z = A\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}} Z \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (91)$$

And $Z = B\ell^{\frac{\alpha}{\frac{C_A}{K_{Ao} + C_A}}Z}$ ……………… (92)

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Put (91) and (92) into (84) gives

$$Cs_6 = A\ell^{\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}}} B\ell^{\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (93)$$

$$Cs_6 = AB\ell^{(x-x)} \frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}} x \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (94)$$

Subject equation (93) and (94) into (94) yield

$$Cs_6 = (o) = C_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (95)$$

So that equation (96) becomes

$$Cs_6 = Cs_o \, \ell^{(x-x)\frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (96)$$

The depositions of Fluid are influenced by structural stratification of the formation. Alluvium developing from sea deposition, it is structured are under the influence of its geological setting that develops predominant of homogeneous formation in some region of okirika. The expressed condition generated lots of formation characteristics influence as well as climatic conditions predominant in deltaic environment. The deposited homogenous formation in the study location experienced constant flow of potassium and lead under the influence of steady rate of flow in the formation. These expressions developed the condition of constant concentration on the derived solution stated above.

Now, assuming that at the steady flow there is no NKP for substrate utilization, our concentration is zero so that equation (96) becomes

$$Cs_6 = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (97)$$

Therefore, solution of the system is of the form

$$Cs = Cs_1 + Cs_2 + Cs_3 + Cs_4 + Cs_5 + Cs_6 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (98)$$

We now substitute (20), (39), (58), (70), (83) and (96) into (98), so that the model is of the form

$$C = Cs_o + Cs_o \, \ell \frac{-n^2\pi^2 V}{2\frac{C_A}{K_A + C_A}} Cos \frac{n\pi}{2} Z + Cs_o \, \ell \frac{-n^2\pi^2 V}{2V} \, Cos \frac{\sqrt{V}}{2} Z +$$

$$Cs_o \, \ell^{(x-t)} \frac{\phi}{Ds} + Cs_o \, \ell^{(t-x)} \frac{\phi}{q_z C_s} + Cs_o \, \ell^{(t-x)} \frac{\alpha}{M_b \frac{\mu_o}{\gamma_o}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (99)$$

$$\Rightarrow Cs = Cs_o \; 1 + \ell \frac{-n^2\pi^2 V}{2\frac{C_A}{K_A + C_A}} Cos \frac{n\pi}{2} + \ell \frac{-n^2\pi^2 V}{2V} + Cos \frac{n\pi}{2} +$$

$$\ell^{(t-z)}\frac{\phi}{q_z C_s} + \ell^{(t-x)}\frac{\phi}{M_b \frac{\mu_o}{\gamma_o}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (100)$$

The developed governing equation derivation expression in (100) is the final model stated above. These systems produced the principal equation derived to generate this model at (100). All the influential parameters that pressured the deposition of potassium and lead in semi confined beds were all integrated in the derived governing equation. Environmental factors were considered in the system, which may have been insignificant in the governing equation, but are integrated in the study. Such conditions were expressed on the parameters from formation characteristics that influenced by high rain intensities. This notion was thoroughly articulated in the system and it generated the governing equation expressed above. All the influential parameters are expressed in the derived solution to generate the final model equation for the study.

4. Conclusion

Potassium and lead has been confirmed to deposit in some region of Okirika influenced by Benin through alluvium deposition. Semi confined beds were confirmed to develop slight in some region of Okirika, depositing homogenous fine and gravel formation including high degree of porosity. Dispersion influences were monitored based on high degree of porosity where potassium and lead are deposited in fine and gravel formation. The study is essential since alluvium are predominant of homogeneous formation, it was found to deposit semi confined beds developing high dispersing rate of potassium and lead under the influence of homogenous fine strata. Experts will from the developed model will useful preventing the migration of these pollutants; this will be a guided baseline to monitor such pollution transport to semi confined bed in the study location.

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