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Research article

PREDICTIVE MODEL TO MONITOR THE DEPOSITION OF AMMONIA AND DEGREE OF VOID RATIO INFLUENCED BY KLEBSIELLA ACCUMULATION IN ORGANIC SOIL, CHOBA DUMP SITE, RIVERS STATE OF NIGERIA

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Abstract

High percentage of Void ratio were found to deposit in organic soil, there are lots of developed influences that should cause high degree of void ratio, climatic condition that generates high degree of rain intensities were found to expressed fast increase of fluid flow depositing several minerals and other solute in organic soil, such condition generate lots of contaminants in organic soil, but the focus of these studies centred on the deposition of ammonia in the formation, the deposition of ammonia were found to increase in organic soil under the influences of void ratio in the soil formation, the accumulation of ammonia and klebsiella were found in organic soil, this condition implies that ammonia enhance the population of klebsiella in the formation. The generation of ammonia are from manmade activities and deposited natural origin, further migration to other formation due the rate of accumulation under the influences of regeneration were observed in the study location, this is to prevent or setup base line that will solve these problem, mathematical modeling approach were found suitable for the study, the expressed parameters generated a system that developed the governing equation, the expressed equation were derived to generate model that will monitor and predict the deposition of klebsiella in the study area.

Keywords: predictive model, ammonia klebsiella accumulation, void ratio and organic soil

Introduction

The regional geology has been mapped and described by Wells and O'Brien (1994a and 1994b bread 2005) 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, Eluozo and Nwaoburu 2013).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,Eluozo and Nwaoburu,2013). 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 esp ecially 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 ammonia in soil are not found to be important to expert in contamination migration studies, numerous contamination from microorganisms remain on increasing up till now the sources of enhance are only accredited to renewal of indiscriminate dump of waste in the environments, but it has now been verify in the study location that it is not merely such waste production that actually boosting the deposition of microorganisms in soil and water environments the stated condition of microelement ammonia were found to deposition in natural state exclusive of manmade activities, although it has been establish that the boost of the microelements are the integration of manmade activates in some area, but not frequently. The study center on the establishing of ammonia deposition in natural state and its pace of void ration under the influences of geomorphology and geochemistry at usual condition, these expression replicate the condition were response on the microbial worlds are effective or where there propensity of other mineral developing competitions for inhibition or enhance in deposition of microorganisms in soil and water environments., these situation require to express some forecast and monitoring the response and deposition of ammonia 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 organic soil formation, the deposition of this klebsiella in this formation replicate low void ratio of the formation and as such enhance buildup of the ammonia that enhance microbial inhabitants of klebsiella in the study area.

3. Governing equation

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

Klebsiella influences from ammonia and void ration of the formation is tp predict the refection of low degree of void ration on the accumulation of klebsiella, this is expressed through the governing equation, monitoring Klebsiella deposition under the influences of void ratio and ammonia deposition in organic soil formation are found to deposit low degree of void ratio in the formation developing lot of accumulation in organic soil, the deposition of this formation are monitored within a region of the soil under batch system application developed the system, the study has express the rate of ammonia deposition which can be of course be manmade actions, consequently the study from organic soil give imminent from its deposition level, the concept has notified further increase on movement of migration of Klebsiella in organic soil to another formation .

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

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

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

$$\left.\begin{aligned} t &= 0 \\ z &= 0 \\ Cs_{(o)} &= 0 \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$\frac{\partial Cs_2}{\partial t}\Big| t = 0, B$$

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

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

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

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

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

The idea of this mathematical approach is to descretize the equations according to various situation that the ammonia influence the microbes under the influence of batch system within the region of organic soil formation , this condition were found essential since it's ammonia that is subject of concern on the growth rate of microbes in soil and water environments, so it is imperative to ensure that the substrate is thoroughly examined to monitor the rate of deposition at various formation, thus predict their depositions at different depths in the study area.

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

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

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

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

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

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

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

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

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)

At $\frac{\partial Cs_1}{\partial t}\Bigg|_{t\,=\,0} = 0\ \ Cs_{(o)} = Cs_o$

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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

$$Vs_1 = VCs_1t - q_zCs_1t + K_1t + Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (22)$$

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

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

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

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

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

i.e. $Cs_2 = ZT \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (26)$

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

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

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

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

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

Hence $\dfrac{VT^1}{T} = -\lambda^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (31)$

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

From (32) $T = ACos\dfrac{\lambda t}{V} + B\ Sin\dfrac{\lambda z}{V} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (33)$

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

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

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

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

Equation (2) derived by direct integration of some parameters was in accordance with the system, directed integration were found necessary to couple the variables they have similarity ,this is base on the deposition of the ammonia reflecting the concentration of the microbes from organic soil, it is confirmed that the concentration of ammonia and Klebsiella experience high degree of concentration. Variable were found to express their relation with each other in terms of their influences of increase include deposition of ammonia increase in microbial inhabitants in organic soil, the accumulations of ammonia are very high.

Equation (35) becomes

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

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

Equation (37) becomes

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

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

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

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

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

So that equation (30) becomes

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

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

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

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

$$Cs_3 = ZT \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (44)$$

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

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

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

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

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

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

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

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

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

And (45) gives

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

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

$$Cs_3 = \left[A\,Cos\frac{\lambda}{V}Z + B\,Sin\frac{\lambda}{\sqrt{V}}Z \right] Cos\ell^{\frac{-\lambda^2}{M_b\frac{\mu_o}{\gamma_o}}t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (54)$$

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

$$Cs_o = Ac \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (55)$$

comparable circumstances are expressed in equation (55) ammonia depositions migrating to organic soil are establish to deposit elevated concentration of microelement, due the low degree of void ratio, therefore the propensity of buildup waiting for high degree of saturation is to enable it migrate to were degree of void ratio deposit higher other formation, 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

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

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

Equation (58) becomes

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

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) express the influence of the ammonia in terms of increase in microbial population, this condition were considered in these various in these two equations, microbial inhabitants expressed is to monitor the formations were microbes are predominant. The equations take care of the rate of ammonia deposition in the formations, the equation in (40) and (55) expressed the results of high degree of void ratio in the formations, the above expressed equation replicate the penalty of ammonia deposition, the expression is to monitor microbial population, including high degrees of feeding from the ammonia deposition in the formations. This condition generates lots of variations in klebsiella behaviour in different dimensions. More so the degree of ammonia considered in the state of microbial transport determined the rate of reaction that may be due to inhibition from other influence that deposit in soil and water environment.

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

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

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

So that equation (61)

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

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

Now we consider equation (8)

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

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

$$Cs_4 = ZT \qquad \text{..................} \qquad (63)$$

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

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

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

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

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

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

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

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

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

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

Subject equation (69) to (8) yield

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

So that equation (73) becomes

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

Now, we consider equation (10)

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

Apply Bernoulli's method, we have

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

So that equation (84) and (85) becomes

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

Now, we consider equation (12)

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

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

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

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

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$$\frac{\partial Cs_6}{\partial Z} = Z^1 T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (90)$$

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

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

$$\frac{Cs_6}{Ks_o + Cs_6} \frac{T^1}{T} = \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (93)$$

$$M_b \frac{\mu_o}{\gamma_o} \frac{Z^1}{Z} = \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (94)$$

And $$Z = B\ell \frac{\alpha}{Ks_o + Cs} Z \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (95)$$

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

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

$$Cs_6 = AB\ell^{(x-t)} M_b \frac{\mu_o}{\gamma_o} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (97)$$

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

$$Cs_6 = (o) = Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (98)$$

So that equation (95 and (98) becomes

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

$$\frac{Cs_7}{Ks_o + Cs_7} \frac{\partial Cs_7}{\partial t} + qzCs \frac{\partial Cs_7}{\partial z} = 0 \quad \ldots\ldots\ldots\ldots \quad (7)$$

$$Cs_7 = ZT \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (100)$$

$$\frac{\partial Cs_7}{\partial t} = ZT^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (101)$$

$$\frac{\partial Cs_7}{\partial Z} = Z^1 T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (102)$$

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

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$$ZT^1 \frac{Cs}{Ks_o + Cs} = Z^1T\, qzCs \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (103)$$

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

$$\frac{Cs}{Ks_o + Cs} \frac{T^1}{T} = \rho \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (105)$$

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

$$T = A \frac{\rho}{\frac{Cs}{Ks_o + Cs}} t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (107)$$

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

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

$$Cs_7 = A\ell^{\frac{\rho}{qzCs}t} \; B\ell^{\frac{\rho}{qzCs}Z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (109)$$

$$Cs_7 = AB\ell^{-(x-t)} \frac{\rho}{qzCs} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (110)$$

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

$$Cs_7 = (o) = Cs_o \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (111)$$

So that equation (109) and (110) becomes

$$Cs_7 = A\ell^{\frac{\rho}{qzCs}t} \; B\ell^{\frac{\rho}{qzCs}Z} \quad \ldots\ldots\ldots\ldots\ldots \quad (112)$$

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

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

Applying Bernoulli's method, we have

$$Cs_8 = ZT \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (113)$$

$$\frac{\partial Cs_8}{\partial t} = ZT^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (114)$$

$$\frac{\partial Cs_8}{\partial Z} = Z^1T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (115)$$

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

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$$\frac{Cs_6}{Ks_o + Cs_6} ZT^1 = Ds\, Z^1 T \qquad \text{.................} \qquad (116)$$

i.e. $$\frac{Cs}{Ks_o + Cs} \frac{T^1}{T} = Ds \frac{Z^1}{Z} \qquad \text{.................} \qquad (117)$$

$$\frac{Cs}{Ks_o + Cs} \frac{T^1}{T} = \theta \qquad \text{.................} \qquad (118)$$

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

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

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

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

$$Cs_8 = A \frac{\theta}{\dfrac{Cs}{Ks_o + Cs}} B\ell^{\frac{\theta}{Ds}} \qquad \text{.................} \qquad (122)$$

$$Cs_8 = AB\ell^{(t-x)} \frac{\theta}{Ds} \qquad \text{.................} \qquad (123)$$

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 expressions in this condition establish Steady states considered in equation (125), the deposition of substrate were expressed under the influences of high degree of void ration variation in the stratum. But in most condition where the organic soil experienced homogeneous deposition at the same time ammonia maintained uniformity concentration in deposition, it implies that in organic soil there the tendency of uniform flow of the ammonia and microbial concentration in the formation, therefore such condition may result to uniform flow and concentration from the ammonia and klebsiella concentration, so equation (125) expressed such condition in the system, this replicate the behaviour assumed in the migration of the contaminant and the deposition of ammonia in the study location.

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

$$Cs_8 = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (126)$$

equation (126) describe this condition when ammonia is inhibited thus if the deposition of ammonia experienced lag phase including ammonia in the stratum, this condition are possible in the sense that the way some formations ammonia may experienced inhibition in organic soil through constant generation of other deposited minerals , thus the concentration will become zero, it implies that there is no deposition of substrate in those formation as expressed in equation (126)

Therefore, solution of the system is of the form

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

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

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

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

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

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

$$C_o \, \ell^{(t-x)} \frac{V}{\frac{CA}{KA+CA}} + \ell^{(t-x)} \frac{\phi}{\frac{CA}{CA_o+CA}} + \ell^{(t-x)} \frac{\varphi}{M_b \frac{\mu_o}{\gamma_o}} + \ell^{(t-x)} \frac{\rho}{qzCs} + \ell^{(t-x)} \frac{\theta}{Ds} \quad (129$$

The derived mathematical model in (129) is from the rearranged equation that considered numerous conditions that could influence the deposition of ammonia in the study location. The deposition of ammonia were investigated thoroughly from different setting in the study location, these course were itemizes, in modifying the developed principal equation, numerous situation that pressure the behaviour of ammonia deposition were also expressed in the system, since ammonia are substrate to microbial growth thus determined the inhabitants of the microorganism in organic soil, these condition were streamlined in the derived model at various stage, the behaviour of ammonia deposition establish the concentration variables denoted mathematically in the system, this condition were determined through the boundary values as express in the derived model , several phase were expressed on the development of the model denoting it through various mathematical tools, from organic soil formation, the rate of concentration of the ammonia determined the rate of concentration of klebsiella under usual state, situations where the deposition are very high and there is degradation of the microbes were 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 klebsiella in organic soil and predict the migration rate to another formation.

4. Conclusion

Ammonia is generally deposited in our surroundings in the course of made activities and natural origin. Ammonia deposits in the study area are from made activities and natural origin, the level of concentration in the study location were established to be very high, and the examination from risk evaluation generated the rate of ammonia concentration. This level of deposition are reflected on the high deposition of klebsiella in the study area, the migration of klebsiella in organic soil varied, these expression were examined from risk evaluation also, this condition were reflected from manmade activities and deposited natural origin in the study location, predominantly of klebsiella are found through risk evaluation, this condition implies that high deposition of ammonia has enhance the concentration of the klebsiella in organic soil in the study area, the derived mathematical models developed will definitely maintained the prevention of pollution and determine the concentration of ammonia and predict further migration of klebsiella in organic soil to another formations.

References

[1] Beard, D., 2005. Using VRML to Share Large Volumes of Complex 3D Geoscientific Information via the Web.Web3D 2006 11th International Conference on 3D Web Technology, Columbia, Maryland, 18-21 April 2006. ACM163-167.

[2] Beard, D.J., Hay, R.J., Nicoll, M.G. and Edge, D.O., 2005. 3D Web Mapping – 3D Geoscience Information Online. In Proceedings of SSC 2005 Spatial Intelligence, Innovation and Praxis: The national biennial Conference of the Spatial Sciences Institute, September 2005.Melbourne: Spatial Sciences Institute.

[3] Biggs, A.J.W., 2000. Geology and Landform. Chapter 3: Central Darling Downs Land Management Manual: Understanding and Managing Land. CD produced by the Queensland Department Natural Resources and Water.

[4] Stevens, N.C., 1969. The Tertiary volcanic rocks of Toowoomba and Cooby Creek, South-east Queensland. Proc. R. Soc. Qd: 80/7:85-96.

[5] Whitaker, W.G. and Green, P.M., 1978. Moreton Geology: 1:500 000 scale map. Geological Survey of Queensland, Department of Mines. [6] Willey, E.C., 1992. Geology of the Hodgson Creek Catchment. Report to Hodgson Creek Catchment Committee (Unpublished).

[7] Willey, E.C., 2003. Urban geology of the Toowoomba conurbation, SE Queensland, Australia. Quaternary International, 103: 57-74.

[8] Ollier, C.D. and Haworth, R.J., 1994. Geomorphology of the Clarence-Moreton Basin. In: Wells, A.T. and O'Brien, P.E. (Eds.). Geology and Petroleum Potential of the Clarence-Moreton Basin, New South Wales and Queensland. AGSO Bulletin 241.

[9] Wells, A.T. and O'Brien, P.E. (Compilers and Editors), 1994b. Geology and Petroleum Potential of the Clarence-Moreton Basin, New South Wales and Queensland. AGSO Bulletin 241

[10] Albrecht, B.A. and Benson, C.H. (2001). "Effect of desiccation on compacted natural clays", J. Geotech. And Geoenv. Engineering, ASCE, 127 (1), pp 67-75.

[11] Daniel, D.E., and Benson, C.H. (1990). "Water content density criteria for compacted soil liners", J. Geotech. Engrg., ASCE 116 (12), pp 1811 – 1830
.

[12] Shackelford, C.D. (1990) Transit-time Design of Earthen Barriers. Engrg. Geol., 29,Elsevier Sc. Pub. B.V., Amsterdam, pp. 79-94.

[13] Shackelford, C.D. (1993) Contaminant transport, Geotech. Prac. for Waste Dis., D.E. Daniel, (eds), Chapman and Hall, London, pp. 33-65.

[14] Shackelford, C.D. (1994) Waste-soil interactions that alter hydraulic conductivity. In D.E. Daniel and S.Y. Trautwein (eds), Hyd. Cond. and Waste Cont. Tranp. in soil, ASTM STP 1142, ASTM Philadelphia, pp. 111-168
.

[15] Shackelford, C.D. (2000) Analytical models for cumulative mass column testing, Proc. Of a speciality conf.,Geotech. Engrg. and Envir. Engrg. Div/ASCE, New Orleans Louisiana.

[16] Ibrahim B 2006 Influence of fines content on water and chemical flows through compacted lateritic soil liners Ph.D dissertation Department of civil engineering, Ahmadu Bello University, Zaria – Nigeria
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[17] Eluozo, S. N, Nwaoburu A .O modeling accumulation of ionic content in aquiferous zone influenced by permeability and seepage velocity in Kaiama, Bayelsa state of Nigeria American journal of environment, energy and power research vol. 1, no. 7, September 2013, pp: 131 -138,