World Journal of Science and Technology Research
Vol. 1, No. 4, June 2013, PP: 75-89, ISSN: 2329 - 3837 (Online)
Available online at www.wjst.org

Research article

MODELS ANALYSIS TO PREDICT THE DEPOSITIONS OF AMMONIA ON E.COLI TRANSPORT IN HOMOGENEOUS COARSE AND FINE SAND IN COASTAL AREA OF DEGEMA, RIVERS STATE OF NIGERIA

Eluozo, S. N.

Subaka Nigeria Limited, Port Harcourt, Rivers State of Nigeria
Director and Principal Consultant, Civil and Environmental Engineering, Research and Development
E-mail: Soloeluozo2013@hotmail.com
E-mail: solomoneluozo2000@yahoo.com

Abstract

There are several challenges in the coastal area of Rivers State on microbial deposition, this is due to deltaic nature of the formation confirmed to establish lots of environmental influences, this condition are influenced by high degrees of formation characteristics and pollution deposition in the study area. Model analysis to predict the deposition of Ammonia on E.coli transport in homogeneous coarse and fine sand were mathematically evaluated. The study confirm the stratification of the formation to be homogeneous, such condition influence the deposition of ammonia, and reflect it on the deposition and transport of E.coli in the study location, model were developed analytically through governing equations, this generated simulation of the model, it produced theoretical values that were compare with experimental model values through resolved best fits equations, the study showcase analytical values expressed to produce theoretical values, these values were compared with experimental model values , it was done to establish a relationship between both models, this is to ensure that perfect predictive models are applied to monitor the deposition of the microelements in the study location, the analytical and experimental methods finally established a relationship, both predictive models can be applied to monitor the deposition of ammonia under the influences of E.coli transport in homogeneous coarse and fine sand in the study area.

Keywords: model analysis, deposition of ammonia, and coarse sand

1. Introduction

Groundwater may be polluted, when wastewater penetrated into the soil and recharges groundwater via leaking sewerage systems, seepage from manure, wastewater or sewage sludge dispersing by farmers on fields, waste from creatures feedlots, waste from healthcare amenities, seepage from waste discarding sites and landfills, or artificial renew of treated waste water. If the distance from source of contamination to spot of abstraction is small, there is a real possibility of abstracting pathogens. To forecast the presence of pathogens in water, usually a separate group of microbes is used. The ordinary expressive period for this group of organisms is fecal indicator organisms (Medema et al., 2003), from which *Escherichia coli* (or *E. coli*) and thermotolerant coliform microorganisms are two significant members. *E. coli* is widely favorite and used as an index of fecal pollution (World Health Organization, 2003), because its discovery is comparatively simple, fast and consistent, and the organism is regularly calculated in water samples throughout the world. The same applies to thermotolerant ('fecal') coliforms. These coliforms are a less consistent index of fecal pollution than *E. coli*, although under most conditions their concentrations are directly related to *E. coli* concentrations (World Health Organization, 2003). Viruses may be considered more critical to groundwater quality than *E. coli*. Because of their smaller size, stability, and negative charge, they may be transported even further through the ground, and because of their infectiousness they represent a major threat to public health Ground water resources are heavily used for domestic drinking water supplies in the United States and most of the world. Nationally, 40% of the U.S. domestic water supply originates from ground water. Furthermore, over 40 million people use ground water to supply their drinking water via domestic wells (Alley 1999). Of public water systems in the U.S., 92% rely primarily on ground water for supply (Craun 2002). Worldwide, ground water represents a large majority of the drinking water supply in many nations, including Denmark, Portugal, Italy, Switzerland, Belgium, and the Netherlands, all of which derive more than 2/3 of their drinking water from ground water (Pedley and Howard 1997). Aquifers have, until the last few decades, been generally considered protected from potential sources of microbial or chemical contamination typically found in surface waters. Due to increasing population densities, agriculture, development and industrialization, and increased withdrawals from aquifers, however, the quality of ground water is increasingly a concern. Numerous instances of ground water contamination and waterborne illness due to ingestion of ground water have been documented. Microbial contamination of ground water has been responsible for many disease outbreaks. In the U.S., at least 356 outbreaks of disease caused by contaminated ground water were documented between 1971 and 1994, representing 58% of all waterborne illness outbreaks (Craun and Calderon 1997). Data for a more recent period (1991 - 1998) indicated that 74 outbreaks of waterborne illness occurred due to public water systems that used ground water, representing 68% of the waterborne disease outbreaks during that period (Craun 2002). This is likely an underestimation of overall incidence of illness due to frequent non detection of outbreaks and a lack of reporting on sporadic and self-resolving illnesses. However, serious consequences can be the result, as estimated annual waterborne disease deaths in the U.S. were reported in one review to be 900 - 1800 (Macler and Merkle 2000). In developing countries in Asia, South America and Africa for an estimated 1,300 million urban dwellers the main source of drinking water is groundwater (Foster, 2000). This groundwater may be contaminated by infiltrated wastewater, because very often a sewer system is not present and households dispose of their solid and liquid waste on-site. For instance, in Africa around 80% of the population in the largest cities (in Asia: around 55%) have on-site sanitation, such as septic tanks, pour-flush, VIP latrines or

simple pits (World Health Organization, 2000-2003). To predict the presence of pathogens in water, a separate group of microorganisms is usually used, generally known as fecal indicator organisms (Pedley et al., 2005). Many microorganisms have been suggested as microbial indicators of fecal pollution (like enterococci, coliphages and sulphite reducing clostridial spores; Medema et al., 2003), but two of the most important indicators used worldwide are *Escherichia coli* and thermotolerant coliform bacteria (for microbiological definitions of these indicators, Both are widely used, because their detection is relatively simple, fast, and reliable. *E. coli* is the preferred indicator of fecal contamination, as it is the only member of the thermotolerant coliform group that is invariably found in feces of warm-blooded animals and it outnumbers the other thermotolerant coliforms in both human and animal excreta (Medema et al., 2003). Thermotolerant coliforms are a less reliable index of fecal contamination than *E. coli*, although under most circumstances their concentrations are directly related to *E. coli* concentrations (Payment et al., 2003). Viruses may be considered as the most critical or limiting microorganism. Because of their small size, their mostly negative surface charge, and their high persistence in the environment, they may travel long distances in the subsurface. In addition, they can be highly infectious (Schijven, 2001). In the study by Karim et al. (2004a), water from 20 groundwater wells from 11 US states was monitored monthly for one year for the presence of culturable viruses, nucleic acid of enteric viruses Some of the reviews concentrate on the movement of bacteria and viruses in aquifers in a qualitative way, without attempting to predict their migration (e.g. Romero, 1970; Lewis et al., 1980; Hagedorn et al., 1981; Crane and Moore, 1984; Bitton and Harvey, 1992; Stevik et al., 2004). Others mainly focus on first-order die-off rates, thereby neglecting the transport component including attachment and detachment processes (e.g. Reddy et al., 1981; Barcina et al., 1997). Murphy and Ginn (2000) mainly summarize the mathematical descriptions of the various physico-chemical and biological processes involved in the transport of bacteria and viruses, without indicating the relative importance of these processes and their occurrence in the natural environment. Merkli (1975) and Althaus et al. (1982) have presented a comprehensive bacteria transport model based on the colloid filtration theory (Herzig et al., 1970; Yao et al., 1971), including the effects of dispersion, diffusion, sedimentation, and filtration.

2.1 Governing equation, analytical model

$$\frac{\mu_o}{\mu_n}\frac{\partial K_O}{\partial t} = \frac{\partial K_O}{\partial x} Kv + Kc \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (1)$$

Nomenclature

θ	=	Void Ratio
K	=	Permeability
V	=	Velocity
T	=	Time
X	=	Distance
h_{AO}	=	Concentration deposition phosphorus
Kc	=	Inhibitors of substrate

$$K_O = XT$$

$$\frac{\partial K_O}{\partial t} = XT^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$\frac{\partial K_O}{\partial X} = TX^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$\frac{\mu_o}{\mu_n}\frac{T^1X}{TX} = \frac{TX^1}{TX} \quad Kv + Kc = -\lambda^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\frac{\mu_o}{\mu_n}\frac{T^1X}{TX} = \frac{X^1}{X} \quad Kv + Kc = -\lambda^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$\frac{\mu_o}{\mu_n}\frac{T^1}{T} = -\lambda^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

$$\frac{X^1}{X} Kv + Kc = -\lambda^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

From (7) $T^1 + \dfrac{\lambda^2 T}{\dfrac{\mu_O}{\mu_N}} = 0$

$$X = ACos\frac{\lambda}{\sqrt{\frac{\mu_O}{\mu_N}}}t + BSin\frac{\lambda}{\sqrt{\frac{\mu_O}{\mu_N}}}t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

From (6) $\dfrac{Z^1}{Z}Kv + Kc - \lambda^2$ …… (9)

$$\frac{Z^1}{Z} = \frac{-\lambda^2}{KvKc} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

By direct integration

$$LnT = \frac{\lambda^2}{KvKc}Z \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

$$Z = D\ell^{\frac{-\lambda^2}{KvKc}Z} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

Combining (8) and (9) yields

World Journal of Science and Technology Research
Vol. 1, No. 4, June 2013, PP: 75-89, ISSN: 2329 - 3837 (Online)
Available online at www.wjst.org

$$Ko\,(Z,t) = \left[A\,Cos\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}t \; + \; B\,Sin\frac{\lambda}{\sqrt{KvKc}}Z \right] D\ell^{\frac{-\lambda^2}{KvKc}Z} \quad \ldots\ldots\ldots\ldots \quad (13)$$

$$At \;= 0 \;\; Ko\,(o) \;=\; Ko$$

$$Ko \;= A\,Cos\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}t \; + \; B\,Sin\frac{\lambda}{\sqrt{KvKo}}Z$$

$$\frac{\partial Ko}{\partial t}\Bigg| \begin{matrix} = \; 0 \\ t \; = \; 0, B \end{matrix} \quad \ldots\ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (14)$$

$$From\ (13)\ \ \frac{\partial Ko}{\partial t} \;=\; \left[-\,A\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}\;\; Sin\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}t \;+\; B\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}\;\; Cos\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}t \right] D\ell^{\frac{-\lambda^2}{KvKc}Z} \quad \ldots\ldots\ldots \quad (15)$$

$$At\ t = 0$$

$$0 \;=\; B\frac{\lambda}{\sqrt{KvKo}}D\ell^{\frac{-\lambda^2}{KvKc}Z} \;\Rightarrow\; B \;=\; 0\,D \;\neq\; 0 \quad \ldots\ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots \quad (16)$$

$$Ko \;=\; \left[A\,Cos\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}} \right] D\ell^{\frac{-\lambda^2}{KvKc}Z} \quad \ldots\ldots\ldots\ldots \quad \ldots\ldots\ldots\ldots \quad (17)$$

$$Ko \;=\; AD\,Cos\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}t\;\ell^{\frac{-\lambda^2}{KvKc}Z} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (18)$$

$$\frac{\partial Ko}{\partial t} \;=\; AD\frac{-\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}\;\; Sin\frac{\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}}t\;\ell^{\frac{-\lambda^2}{KvKc}Z} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (19)$$

$$At\;\; t \;=\; \frac{\partial Ko}{\partial t} \;=\; 0$$

$$0 = \frac{AD\lambda}{\sqrt{\frac{\mu_o}{\mu_n}}} Sin \frac{\lambda d}{\sqrt{\frac{\mu_o}{\mu_n}}} = n\pi = \frac{\lambda d}{\sqrt{\frac{\mu_o}{\mu_n}}}, \; n = 0,1,2 \qquad \ldots\ldots\ldots\ldots\ldots \qquad (20)$$

$$\Rightarrow \lambda = n\pi \frac{\sqrt{\frac{\mu_o}{\mu_n}}}{d} \qquad \ldots\ldots\ldots\ldots \qquad \ldots\ldots\ldots\ldots \qquad (21)$$

So that we have

$$Ko\,(Z,t) = AD\,Cos\; n\pi \frac{\sqrt{\frac{\mu_o}{\mu_n}}}{d\sqrt{\frac{\mu_o}{\mu_n}}} t \; \ell \; \frac{-n^2\pi^2 \frac{\mu_o}{\mu_n}}{d^2 KvKc} Z \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (22)$$

$$AD\,Cos \frac{n\pi}{d} t \; \ell \; \frac{-n^2\pi^2 \frac{\mu_o}{\mu_n}}{d^2 KvKc} Z \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (23)$$

Hence $AD = Ko$

$$\boxed{Ko = (Z,t) = Ko \; \ell \; \frac{-n^2\pi^2 \frac{\mu_o}{\mu_n}}{d^2 KvKc} Z \; Cos \frac{n\pi}{d} t} \qquad \ldots\ldots\ldots\ldots\ldots \qquad (24)$$

2.2 Theoretical Background Experimental model

Theoretical background for 3rd degree polynomial curve fitting

General: $y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + \ldots\ldots\ldots + a_n x^n$

If the above polynomial fits the pair of data (x, y) it means that every pair of data will satisfy the equation (polynomial).

Thus; $y_1 = a_0 + a_1 x_1 + a_2 x_1^2 + a_3 x_1^3 + \ldots\ldots\ldots + a_n x_1^n$ ..... (25)

$y_2 = a_0 + a_1 x_2 + a_2 x_2^2 + a_3 x_2^2 + \ldots\ldots\ldots + a_n x_2^n \ldots$ ..... (26)

$y_3 = a_0 + a_1 x_3 + a_2 x_3^2 + a_3 x_2^2 + \ldots\ldots\ldots + a_n x_2^n$ ..... (27)

$$y_4 = a_0 + a_1 x_4 + a_2 x_n^2 + a_3 x_n^2 + \ldots\ldots\ldots + a_n x_4^n \qquad \ldots\ldots\ldots\ldots \qquad (28)$$

Summing all the equations will yield (1 → n)

$$\sum_{i=1}^{i=n} y_i = \sum a_0 + \sum_{i=1}^{i=n} a_1 x_i + \sum_{i=1}^{i=n} a_2 x_i^2 + \sum_{i=1}^{i=n} a_3 x_i^3 + \sum_{i=1}^{i=n} a_4 x_i^4 + \ldots\ldots + \sum_{i=1}^{i=n} a_n x_i^n$$

$$\boxed{\sum_{i=1}^{i=n} y_i = n a_0 + a_1 \sum_{i=1}^{n} x_i + a_2 \sum_{i=1}^{n} x_i^2 + a_3 \sum_{i=1}^{n} x_i^3 + \ldots\ldots + \sum_{i=1}^{n} x_i^n} \qquad \ldots\ldots\ldots\ldots \qquad (29)$$

To form the equations to solve for the constants $a_0, a_1, a_2, a_3, \ldots\ldots a_n$.

We multiply equations (3.84) by $x_{i,}\, x_i^2, x_i^3 \ldots\ldots\ldots x_i^n$.

$$\sum_{i=1}^{1} y_i = n a_0 + a_1 \sum x_i + a_2 \sum x_i^2 + a_3 \sum x_i^3 + \ldots\ldots + a_n \sum x_i^n \qquad \ldots\ldots\ldots \qquad (30)$$

Multiply equation (6) by x_i

$$x_i \sum y_i = n a_0 x_i + a_1 x_i \sum x_i + a_2 x_i \sum x_i^2 + a_3 x_i \sum x_1^3 + \ldots\ldots\ldots + a_n x_i \sum x_i^n$$

$$\sum y_i x_i = a_0 \sum x_i + a_1 \sum x_i^2 + a_2 \sum x_i^3 + a_3 \sum x_i^4 + \ldots\ldots\ldots + a_n \sum x_i^{n+1} \qquad \ldots\ldots\ldots \qquad (31)$$

Multiply equation (6) by x_i^2

$$x_i^2 \sum y_i = n a_0 x_i^2 + a_1 x_i^2 \sum x_i + a_2 x_i^2 \sum x_i^2 + a_3 x_i^2 \sum x_i^3 + \ldots\ldots\ldots + a_n x_i^2 \sum x_i^n \quad .. \qquad (32)$$

$$\sum y_i x_i^2 = a_0 \sum x_i^2 + a_1 \sum x_i^3 + a_2 \sum x_i^4 + a_3 \sum x_i^5 + \ldots\ldots\ldots + a_n \sum x_i^{n+2} \qquad \ldots\ldots\ldots \qquad (33)$$

Multiply equation (3.85) by x_i^3

$$x_i^3 \sum y_i = n a_0 x_i^3 + a_1 x_i^3 \sum x_i + a_2 x_i^3 \sum x_i^2 + a_3 x_i^3 \sum x_i^3 + \ldots\ldots\ldots + a_n x_i^3 \sum x_i^n$$

$$\sum y_i x_i^3 = a_0 \sum x_i^3 + a_1 \sum x_i^4 + a_2 \sum x_i^5 + a_3 \sum x_i^6 + \ldots\ldots\ldots + a_n \sum x_i^{n+3} \qquad \ldots\ldots\ldots \qquad (34)$$

World Journal of Science and Technology Research
Vol. 1, No. 4, June 2013, PP: 75-89, ISSN: 2329 - 3837 (Online)
Available online at www.wjst.org

Multiply equation (6) by x_i^n

$$x_i^n \sum y_i = a_0 n x_i^n + a_1 x_i^n \sum x_i + a_2 x_i^n \sum x_i^2 + a_3 x_i^n \sum x_i^3 + \ldots\ldots\ldots + a_n x_i^n \sum x_i^n$$

$$= a_0 \sum x_i^n + a_1 \sum x_i^{n+1} + a_2 \sum x_i^{n+2} + a_3 \sum x_i^{n+3} + \ldots\ldots\ldots + a_n \sum x_i^{n+n} \quad \ldots\ldots\ldots \text{ n}$$

Putting equation (6) to n into matrix form

$$\begin{bmatrix} n & \sum x_i & \sum x_i^2 & \sum x_i^3 & \ldots\ldots \sum x_i^n \\ \sum x_i & \sum x_i^2 & \sum x_i^3 & \sum x_i^4 & \ldots\ldots \sum x_i^{n+1} \\ \sum x_i^2 & \sum x_i^3 & \sum x_i^4 & \sum x_i^5 & \ldots\ldots \sum x_i^{n+2} \\ \sum x_i^3 & \sum x_i^4 & \sum x_i^5 & \sum x_i^6 & \ldots\ldots \sum x_i^{n+3} \\ \ldots & \ldots & \ldots & \ldots & \ldots \\ \sum x_i^n & \sum x_i^{n+1} & \sum x_i^{n+2} & \sum x_i^{n+3} \ldots\ldots & \sum x_i^{n+n} \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \\ \ldots\ldots \\ a_n \end{bmatrix} = \begin{bmatrix} \sum y_i \\ \sum y_i x_i \\ \sum y_i x_i^2 \\ \sum y_i x_i^3 \\ \ldots \\ \sum y_i x_i^n \end{bmatrix}$$

Solving the matrix equation yields values for constants $a_0, a_1, a_2, a_3, \ldots\ldots a_n$ as the case may be depending on the power of the polynomial.

From the above matrix; for our particular case; i.e. polynomial of the third order:

$$y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 \qquad (33)$$

The equivalent matrix equation will be; ($n = 3$).

$$\begin{bmatrix} n & \sum x_i & \sum x_i^2 & \sum x_i^3 \\ \sum x_i & \sum x_i^2 & \sum x_i^3 & \sum x_i^4 \\ \sum x_i^2 & \sum x_i^3 & \sum x_i^4 & \sum x_i^5 \\ \sum x_i^3 & \sum x_i^4 & \sum x_i^5 & \sum x_i^6 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} \sum y_i \\ \sum y_i x_i \\ \sum y_i x_i^2 \\ \sum y_i x_i^3 \end{bmatrix}$$

3. Results and Discussion

Table 1: Analytical and Theoretical values of Ammonia on E.coli growth Rate

Depth	Theoretical values Analytical	Theoretical values experimental
3	4.35E-06	1.43E-06

6	**8.24E-08**	**2.86E-06**
9	**4.40E-07**	**4.29E-06**
12	**1.57E-05**	**5.71E-06**
15	**2.14E-05**	**6.35E-06**
18	**2.56E-05**	**7.62E-06**
21	**3.03E-05**	**8.89E-06**
24	**3.49E-05**	**1.02E-05**
27	**3.96E-05**	**1.02E-06**
30	**4.44E-05**	**1.27E-05**

Table 2: Analytical and Theoretical values of Ammonia on E.coli growth Rate

Time	Theoretical values Analytical	Theoretical values experimental
10	**1.37E-06**	**1.43E-06**
20	**2.28E-06**	**2.86E-06**
30	**3.37E-06**	**4.29E-06**
40	**3.92E-06**	**5.71E-06**
50	**5.92E-06**	**6.23E-06**
60	**6.29E-06**	**7.62E-06**
70	**7.25E-06**	**8.89E-06**
80	**8.20E-06**	**1.02E-05**
90	**9.15E-06**	**1.14E-05**
100	**1.01E-05**	**1.27E-05**

Table 3: Analytical and Theoretical values of Ammonia on E.coli growth Rate

Depth	Theoretical values Analytical	Theoretical values experimental
3	**1.49E-06**	**2.84E-06**
6	**1.54E-05**	**1.70E-05**
9	**2.41E-05**	**2.55E-05**
12	**3.94E-05**	**3.40E-05**
15	**4.25E-05**	**4.26E-05**
18	**5.49E-05**	**5.11E-05**
21	**5.01E-05**	**5.96E-05**
24	**6.86E-05**	**6.81E-05**
27	**7.69E-05**	**7.67E-05**
30	**9.49E-05**	**8.52E-05**

Table 4: Analytical and Theoretical values of Ammonia on E.coli growth Rate

Time	Theoretical values Analytical	Theoretical values experimental
10	6.20E-07	2.84E-06
20	2.46E-06	1.70E-05
30	5.50E-06	2.55E-05
40	9.74E-06	3.40E-05
50	1.52E-05	4.26E-05
60	2.18E-05	5.11E-05
70	2.96E-05	5.96E-05
80	3.87E-05	6.18E-05
90	4.89E-05	7.67E-05
100	6.03E-05	8.52E-05

Table 5: Analytical and Theoretical values of Ammonia on E.coli growth Rate

Depth	Theoretical values Analytical	Theoretical values experimental
3	6.10E-08	5.96E-08
6	2.42E-07	2.38E-07
9	5.47E-07	5.11E-07
12	9.74E-07	9.53E-07
15	1.52E-06	1.59E-06
18	2.19E-06	2.14E-06
21	2.99E-06	2.90E-06
24	3.91E-06	3.81E-06
27	4.95E-06	4.80E-06
30	6.11E-06	5.96E-06

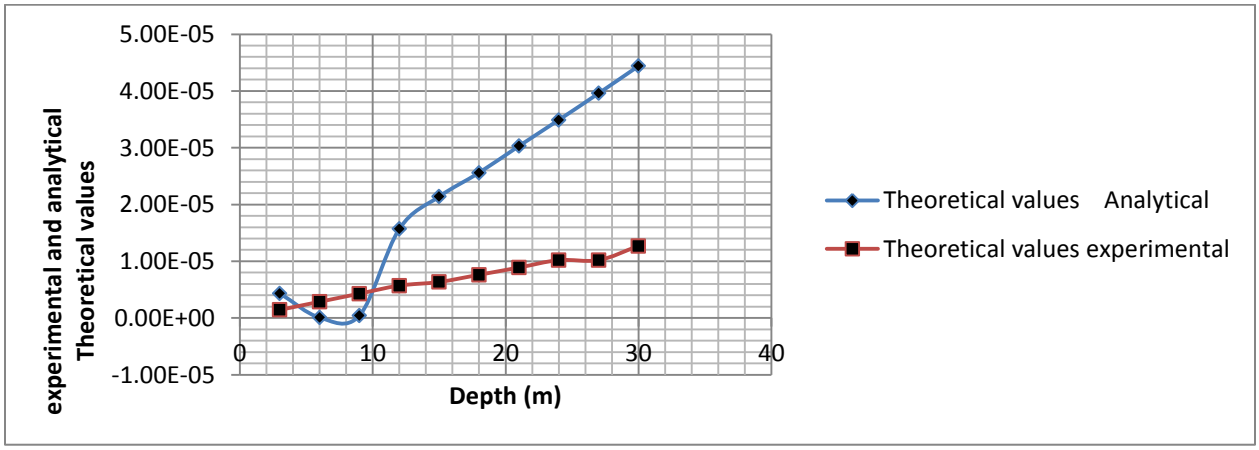

Figure 1: Analytical and Theoretical values of Ammonia on E.coli growth Rate

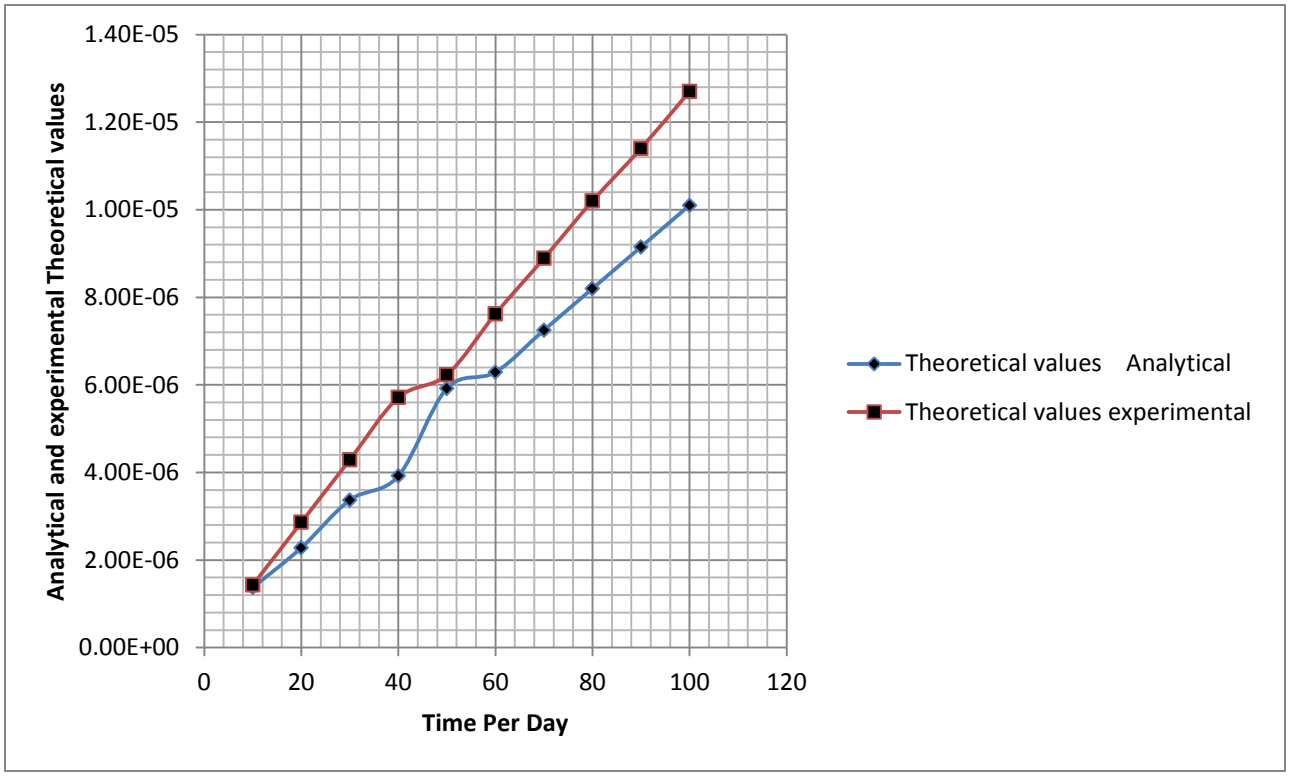

Figure 2: Analytical and Theoretical values of Ammonia on E.coli growth Rate

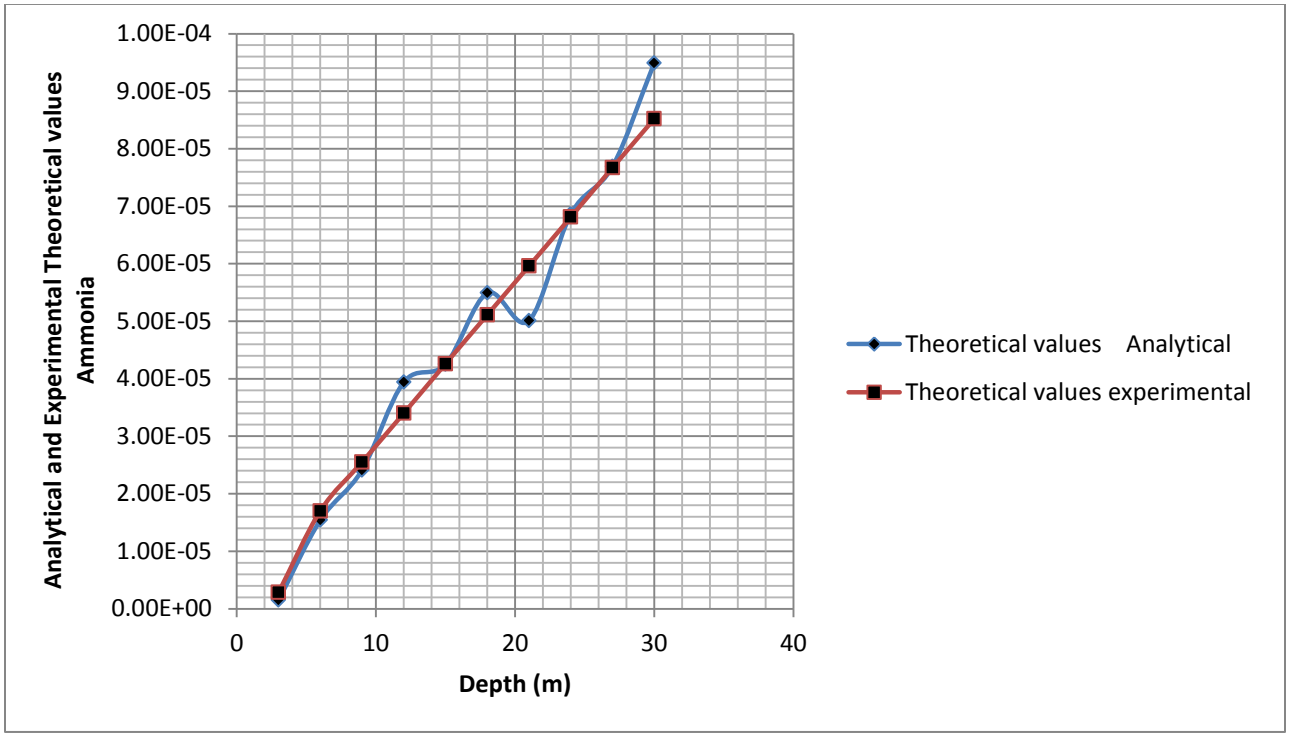

Figure 3: Analytical and Theoretical values of Ammonia on E.coli growth Rate

World Journal of Science and Technology Research
Vol. 1, No. 4, June 2013, PP: 75-89, ISSN: 2329 - 3837 (Online)
Available online at www.wjst.org

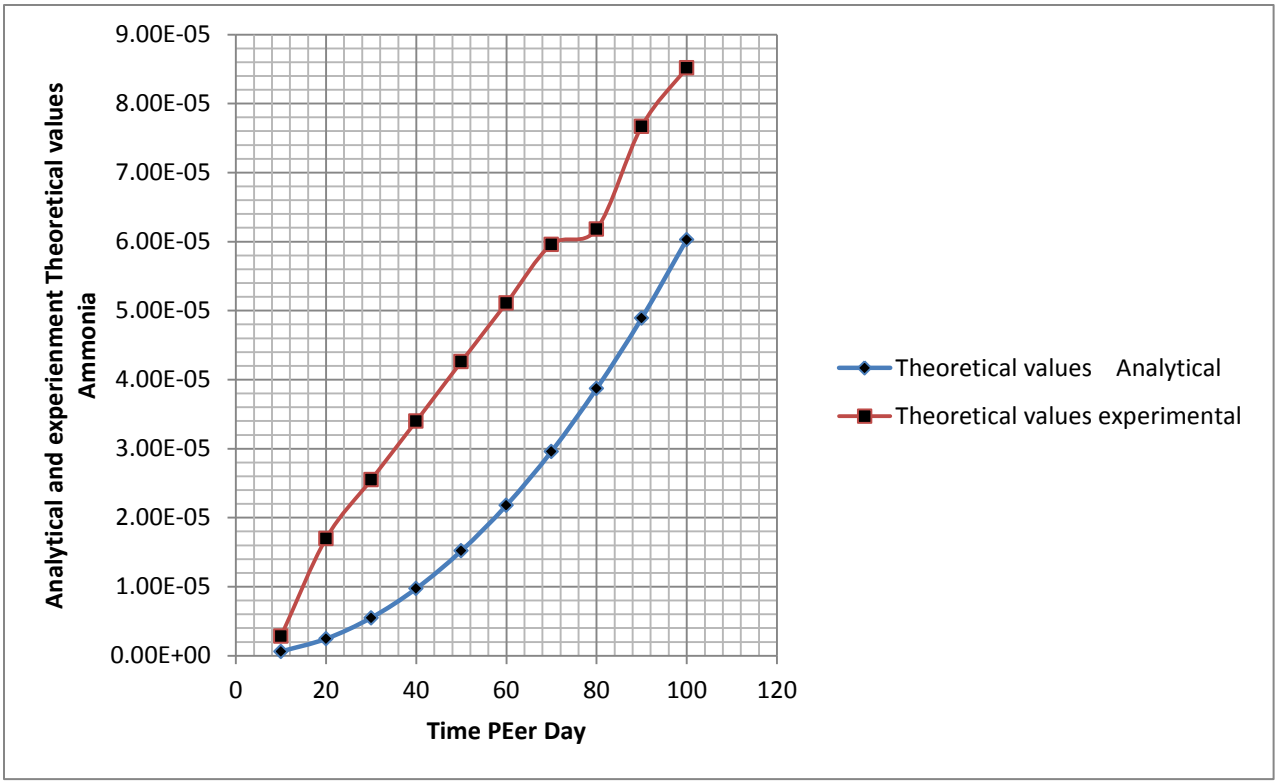

Figure 4: Analytical and Theoretical values of Ammonia on E.coli growth Rate

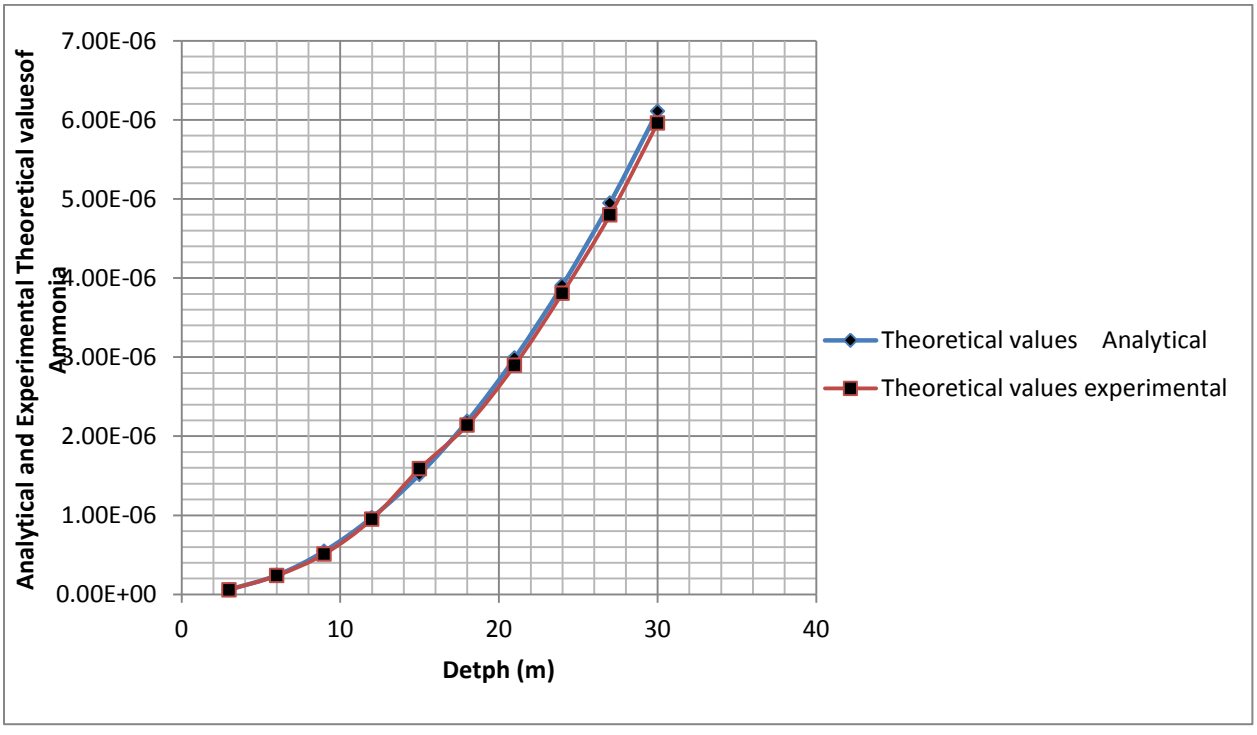

Figure 5: Analytical and Theoretical values of Ammonia on E.coli growth Rate

The e expression in figure 1 shows that the theoretical value developed a slight increase between three to six metres suddenly develop degradation from nine meters rapid increase were experienced to were the optimum values were recorded at thirty metres, .while the analytical values maintained a gradual increase from the lowest at three metres to the optimum values recorded at thirty metres , both parameter are on the exponential phase but were not in the best fit, figure 2 shows that the model from experimental values maintain uniform exponential condition from the lowest rate at ten days to the optimum values recorded at hundred days, while the analytical model values maintained the same trend, the lowest were established at the same ten days and finally experience rapid increase to were the optimum values at hundred days ,similar condition were observed in figure three the experimental; model values rapidly increase it concentration from the lowest at three metres and the highest at thirty metres, rapid increase were observed to where the optimum values were established at thirty metres, while the analytical model values in similar condition observed rapid increase with slight fluctuation between eighteen to twenty one metres from the lowest at three metres to the optimum values recorded at thirty metres. Figure 4 maintained progressive increase in a rapid condition , but observed slight lagging at twenty eighty days , and finally continue it rapid increase to the optimum values recorded at hundred days, while analytical model values developed fast migration of the substrate from the lowest at ten days to the highest at hundred days in linear condition. Figure five produce a gradual increase in concentration from the lowest at three metres to the optimum values at thirty metres both parameters developed a best fit. The experimental and analytical theoretical model values establish a high degree of relationship in the comparative evaluation, this implies that both predictive value can monitor the growth rate of ammonia migration that influence the concentration of E.coli in coastal area of degema, formation characteristics influences were observed in the study area, this were reflected from the figures were the rate of deposition ammonia were on the exponential condition, this situation are from the deposition of formation stratification ,it is reflected from the deposition of the concentration through the exponential condition from the figures presented.

4. Conclusion

Model studies of analytical and experimental theoretical values has been evaluated, this is to establish compared both analysis, and determine there relations in model prediction of ammonia deposition influencing E.coli transport in homogeneous coarse and fine sand. The study is in coastal location in Rivers State, there are lots of deltaic formation influence , this condition were evaluate thus make imperative to establish comparative studies of two different predictive values to monitor the deposition of ammonia on E.col. Formation of this type that has lots of shallow aquifers including high degree of porosity, they are observed to develop lots of challenges in predicting pollution deposition in the study area. These factors find it necessary to establish two different model and compare both results to determine there relationship. The result of both models has been confirmed from the comparative studies carried out, both models values establish a relationship were both results were on exponential phase as presented from the figures , these are reflected on the experimental laboratory analysis that were original compared with the analytical values, before the comparative models, it implies that both parameter compared can perfectly predict the deposition of ammonia reflected on E.coli transport in homogeneous coarse and fine sand. The model

are establish base on the comparative analysis can be applied to predict the deposition of ammonia on E.coli migration in the study area.

References

[1] Althaus, H., K.D. Jung, G. Matthess and A. Pekdeger, 1982. Lebensdauer von Bacterien und Viren in Grundwasserleitern. Umweltbundesamt, Materialien 1/82. Schmidt-Verlag, Berlin

[2] Alley, W. M., Reilly, T. E. and Franke, O. L. (1999). Sustainability of Ground-Water Resources, U.S. Geological Survey Circular 1186. Denver, U.S. Geological Survey.

[3] Craun, G. F., Nwachuku, N., Calderon, R. L. and Craun, M. F. (2002). "Outbreaks in drinking-water systems, 1991-1998." Journal of Environmental Health **65**(1): 16-23.

[4] Macler, B. A. and Merkle, J. C. (2000). "Current knowledge on groundwater microbial pathogens and their control." Hydrogeology Journal **8**(1): 29-40.

[5] Medema, G. J., Bahar, M. and Schets, F. M. (1997). "Survival of Cryptosporidium parvum, Escherichia coli, faecal enterococci and Clostridium perfringens in river water: Influence of temperature and autochthonous microorganisms." Water Sci Technol **35**(11-12): 249-2

[6] Medema, G. J., Bahar, M. and Schets, F. M. (1997). Survival of Cryptosporidium parvum, Escherichia coli, faecal enterococci and Clostridium perfringens in river water: Influence of temperature and autochthonous microorganisms." Water Sci Technol **35**(11-12): 249-2

[7] Pedley, S. and Howard, G. (1997). "The public health implications of microbiological contamination of groundwater." Q J Eng Geol **30**: 179-188.

[8] Foster, S.S.D., 2000. Groundwater resources at the turn of the millennium: taking stock and lookingforward. In: *Groundwater: past achievements and future challenges, Sillo et al. (eds.),*Balkema, Rotterdam, The Netherlands, ISBN 90 5809 159 7.

[9] World Health Organization, 2000-2003. Global Water Supply and Sanitation Assessment 2000 Report. http://www.who.int/docstore/water_sanitation_health/globassessment

[10] Payment, P., M. Waite and A. Dufour, 2003. Introducing parameters for the assessment of drinking water quality. In: *Assessing microbial safety of drinking water: improving approaches and methods, Dufour et al. (eds.).* World Health Organization, 2003. ISBN 92 4 154630.

[11] Schijven, J.F., G. Medema, A.J. Vogelaar, and S.M. Hassanizadeh, 2000. Removal of microorganisms by deep well injection. J. Contam. Hydrol., Vol. 44, p. 301-327.

[12] Romero, J.C., 1970. The movement of bacteria and viruses through porous media. Ground Water (8), p. 37-48

[13] Karim, M.R., F.D. Manshadi, M.M. Karpiscak and C.P. Gerba, 2004b. The persistence and removal of enteric pathogens in constructed wetlands. Wat. Res. (38), p. 1831-1837.

[14] Lewis, W.J., Foster, S.S.D. and Drasar, B.S., 1980. The risk of groundwater pollution by on-site sanitation in developing countries. IRCWD Report No. 01/82. International Reference Centre fr Waste Disposal (IRCWD), Duebendorf, Switzerland

[15] Hagedorn, C., E.L. McCoy and T.M. Rahe, 1981. The potential for ground water contamination from septic effluents. J. Environ. Qual. (10), p. 1-8.

[16] Crane, S.R. and J. Moore, 1984. Bacterial pollution of groundwater: a review. Water, Air, Soil Pollution (22), p. 67-83.

[17] Bitton, G. and R.W. Harvey, 1992. Transport of pathogens through soils and aquifers. In: Environmental Microbiology, edited by R. Mitchell, ISBN 0-471-50647-8, p. 103-124.

[18] Stevik, T.K., K. Aa, G. Ausland and J.F. Hanssen, 2004. Retention and removal of pathogenic bacteria in wastewater percolating through porous media: a review. Wat. Res. (38), p. 1355-1367

[19] Reddy, K.R., R. Khaleel and M.R. Overcash, 1981. Behavior and transport of microbial athogens and indicator organisms in soils treated with organic wastes. J. Environ. Qual. (10), p. 255- 266.

[20] Merkli, B., 1975. Untersuchungen ueber Mechanismen und Kinetik der Elimination von Bakterien und Viren im Grundwasser. Diss. ETH Zurich 5420.

[21] Barcina, I., P. Lebaron and J. Vives-Rego, 1997. Survival of allochthonous bacteria in aquatic systems: a biological approach. FEMS Microbiol. Ecol. (23), p. 1-9.

[22] Murphy, E.M., J. M. Zachara, and S. C. Smith, 1990. Influence of mineral-bound humic substances on the sorption of hydrophobic organic compounds. Environ. Sci. Technol., Vol. 24, p. 1507-1516

[23] Herzig, J.P., D.M. Leclerc, and P. Le Golf, 1970. Flow of suspensions through porous media – Application to deep infiltration. In: Flow Through Porous Media, Am. Chem. Soc., Washington, D.C., pp. 129-157

[24] Yao, K-M, M.T. Habibian and C.R. O'Melia, 1971. Water and wastewater filtration: Concepts and Applications. Environmental Science and Technology Vol. 5, Number 11, p. 1105-1112.

[25] David E. John 2003 Transport and survival of water quality indicator microorganisms in the ground water environment of Florida: Implications for aquifer storage and waste disposal PhD Dissertation University of south Florida pp1-5.

[26] Jan Willem Anton Foppen 2007 Transport of *Escherichia coli* in saturated porous media Taylor & Francis Group plc, London, UK pp- 1-6