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Research Article

Modeling the Transport of Enteric Virus Pressured by Variation of Velocity in Heterogeneous Coarse Deposition in Coastal Environment

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Abstract

This paper monitored the transport of enteric virus applying non-homogeneous system, other works done was monitoring the system influenced by micronutrient in other predominant stratum, but the study looks at the variation of fluid velocity as a determine factor for the migration rate of enteric virus in coarse formation, such condition explained the rate of fluid flow velocity influence in growth rate of the concentration. The study observed linear trend on the migration rate, but at different conditions expressed in different figures, the concentration experienced variation such that the lowest velocity of flow experienced highest concentration, while the highest velocity of flow experienced the lowest concentration, this implies that the developed model express the influenced from variation of velocity refection on enteric virus in heterogeneous coarse deposition. The study is imperative because the previous study monitored the system on the migration rates based on the deposition of microelement that normally increase its population, but present study observed the effect from velocity variation and its rate of deposition as determination factor for the growth rate of the contaminant in the study environment. This implies that the velocity deposition precisely monitors it observation as it become the determination factor for the depositional variation of enteric virus in coarse depositions.

Keywords: Modeling; Transport enteric virus velocity; Coarse deposition

Introduction

In recent two decades, several of experts have carried out studies on batch, flowing column, this also includes field experiments on the subsurface viral performance. Good number of the processes affected in ground water viral fate and transport, results on permanent removal of virus from through irreparable attachment, reversible attachment, and inactivation developed only irreversible attachment. Properties of virus has been observed controlled ground [1-4], the properties of the porous medium [5,6], and the properties of water transporting the virus [7-11]. This process of governing virus fate and transport were observed not to be based on the fact that the study never considers all the controlling factors from the three aspects listed. [12-14] The electrostatic attraction and repulsion, van der Waals forces, and hydrophobic influences are three foremost forces accountable for communication between the virus and the porous medium [15-19].

Theoretical Backgrounds

Nomenclature:

C = Enteric Virus Concentration

A(x) = void Ratio /Porosity of soil

B(x) = Permeability of Soil

C-n-[α_1x] = Velocity of Flow

x = Depth

$$\frac{dc}{dx} + A_{(x)}\, C_d + B_{(x)}\, C_d^n = 0 \quad \text{......................(1)}$$

Transform the above Bernoulli's Equation to a linear first order DE gives:

$$\frac{dk}{dx} + (1-n)k = (1-n)\, B_{(x)}$$

Let I.F = $\ell^{-\alpha x_{1x}}$ .... **(2)**

Use I.F to Solve (2) above

Hence, the general Solution becomes:

$$C_d^{1-n} = -\frac{B}{A} + Ce^{-\alpha_1 x} \quad (3)$$

Materials and Method

Standard laboratory experiment where performed to monitor Enteric Virus using the standard method for the experiment at different formation, the soil deposition of the strata were collected in sequences base on the structural deposition of the lithology at different locations, this samples collected at different location generated variations at different depths producing different Enteric Virus concentration through column experiment, from the pressure flow at different strata, the experimental result were compared with the theoretical values for the validation of the model.

Results and Discussion

Results and discussion are presented in Tables 1-7 including graphical representation for Enteric Virus concentration.

Table1: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	0.00044962	0.0003
6	0.00089924	0.0006
9	0.00134886	0.0009
12	0.00179848	0.0012
15	0.002248099	0.0015
18	0.002697719	0.0018
21	0.003147339	0.0021
24	0.003596959	0.0024
27	0.004046579	0.0027
30	0.004496199	0.003
33	0.004945819	0.0033
36	0.005395439	0.0036
39	0.005845058	0.0039
42	0.006294678	0.0042
45	0.006744298	0.0045
48	0.007193918	0.0048
51	0.007643538	0.0051
54	0.008093158	0.0054
57	0.008542778	0.0057
60	0.008992398	0.006
63	0.009442017	0.0063
66	0.009891637	0.0066
69	0.010341257	0.0069
72	0.010790877	0.0072
75	0.011240497	0.0075
78	0.011690117	0.0078
81	0.012139737	0.0081
84	0.012589357	0.0084
87	0.013038976	0.0087
90	0.013488596	0.009
93	0.013938216	0.0093
96	0.014387836	0.0096
100	0.014987329	0.01

Table 2: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	4.07E-05	0.00003
6	8.14E-05	0.00006
9	1.22E-04	0.00009

12	1.63E-04	0.00012
15	2.03E-04	0.00015
18	2.44E-04	0.00018
21	2.85E-04	0.00021
24	3.25E-04	0.00024
27	3.66E-04	0.00027
30	4.07E-04	0.0003
33	4.48E-04	0.00033
36	4.88E-04	0.00036
39	5.29E-04	0.00039
42	5.70E-04	0.00042
45	6.10E-04	0.00045
48	6.51E-04	0.00048
51	6.92E-04	0.00051
54	7.32E-04	0.00054
57	7.73E-04	0.00057
60	8.14E-04	0.0006
63	8.54E-04	0.00063
66	8.95E-04	0.00066
69	9.36E-04	0.00069
72	9.76E-04	0.00072
75	1.02E-03	0.00075
78	1.06E-03	0.00078
81	1.10E-03	0.00081
84	1.14E-03	0.00084
87	1.18E-03	0.00087
90	1.22E-03	0.0009
93	1.26E-03	0.00093
96	1.30E-03	0.00096

Table 3: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	4.07E-06	0.000003
6	8.14E-06	0.000006
9	1.22E-05	0.000009
12	1.63E-05	0.000012
15	2.03E-05	0.000015
18	2.44E-05	0.000018
21	2.85E-05	0.000021
24	3.25E-05	0.000024
27	3.66E-05	0.000027
30	4.07E-05	0.00003
33	4.48E-05	0.000033
36	4.88E-05	0.000036
39	5.29E-05	0.000039
42	5.70E-05	0.000042
45	6.10E-05	0.000045
48	6.51E-05	0.000048
51	6.92E-05	0.000051
54	7.32E-05	0.000054
57	7.73E-05	0.000057

60	8.14E-05	0.00006
63	8.54E-05	0.000063
66	8.95E-05	0.000066
69	9.36E-05	0.000069
72	9.76E-05	0.000072
75	0.000101708	0.000075
78	0.000105777	0.000078
81	0.000109845	0.000081
84	0.000113913	0.000084
87	0.000117982	0.000087
90	0.00012205	0.00009
93	0.000126118	0.000093
96	0.000130187	0.000096
100	0.000135611	0.0001

Table 4: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	1.23E-06	1.20E-06
6	2.45E-06	2.40E-06
9	3.68E-06	3.60E-06
12	4.90E-06	4.80E-06
15	6.13E-06	6.00E-06
18	7.35E-06	7.20E-06
21	8.58E-06	8.40E-06
24	9.80E-06	9.60E-06
27	1.10E-05	0.0000108
30	1.23E-05	0.000012
33	1.35E-05	0.0000132
36	1.47E-05	0.0000144
39	1.59E-05	0.0000156
42	1.72E-05	0.0000168
45	1.84E-05	0.000018
48	1.96E-05	0.0000192
51	2.08E-05	0.0000204
54	2.21E-05	0.0000216
57	2.33E-05	0.0000228
60	2.45E-05	0.000024
63	2.57E-05	0.0000252
66	2.70E-05	0.0000264
69	2.82E-05	0.0000276
72	2.94E-05	0.0000288
75	3.06E-05	0.00003
78	3.19E-05	0.0000312
81	3.31E-05	0.0000324
84	3.43E-05	0.0000336
87	3.55E-05	0.0000348
90	3.68E-05	0.000036
93	3.80E-05	0.0000372
96	3.92E-05	0.0000384
100	4.08E-05	0.00004

Table 5: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	1.82103E-07	1.8E-07
6	3.64207E-07	3.6E-07
9	5.4631E-07	5.4E-07
12	7.28413E-07	7.2E-07
15	9.10517E-07	9E-07
18	1.09262E-06	0.00000108
21	1.27472E-06	0.00000126
24	1.45683E-06	0.00000144
27	1.63893E-06	0.00000162
30	1.82103E-06	0.0000018
33	2.00314E-06	0.00000198
36	2.18524E-06	0.00000216
39	2.36734E-06	0.00000234
42	2.54945E-06	0.00000252
45	2.73155E-06	0.0000027
48	2.91365E-06	0.00000288
51	3.09576E-06	0.00000306
54	3.27786E-06	0.00000324
57	3.45996E-06	0.00000342
60	3.64207E-06	0.0000036
63	3.82417E-06	0.00000378
66	4.00627E-06	0.00000396
69	4.18838E-06	0.00000414
72	4.37048E-06	0.00000432
75	4.55258E-06	0.0000045
78	4.73469E-06	0.00000468
81	4.91679E-06	0.00000486
84	5.09889E-06	0.00000504
87	5.281E-06	0.00000522
90	5.4631E-06	0.0000054
93	5.6452E-06	0.00000558
96	5.82731E-06	0.00000576
100	6.07011E-06	0.000006

Table 6: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	4.73896E-07	0.0000006
6	9.47792E-07	0.0000012
9	1.42169E-06	0.0000018
12	1.89558E-06	0.0000024
15	2.36948E-06	0.000003
18	2.84338E-06	0.0000036
21	3.31727E-06	0.0000042
24	3.79117E-06	0.0000048
27	4.26506E-06	0.0000054
30	4.73896E-06	0.000006
33	5.21285E-06	0.0000066
36	5.68675E-06	0.0000072
39	6.16065E-06	0.0000078
42	6.63454E-06	0.0000084

45	7.10844E-06	0.000009
48	7.58233E-06	0.0000096
51	8.05623E-06	0.0000102
54	8.53013E-06	0.0000108
57	9.00402E-06	0.0000114
60	9.47792E-06	0.000012
63	9.95181E-06	0.0000126
66	1.04257E-05	0.0000132
69	1.08996E-05	0.0000138
72	1.13735E-05	0.0000144
75	1.18474E-05	0.000015
78	1.23213E-05	0.0000156
81	1.27952E-05	0.0000162
84	1.32691E-05	0.0000168
87	1.3743E-05	0.0000174
90	1.42169E-05	0.000018
93	1.46908E-05	0.0000186
96	1.51647E-05	0.0000192
100	1.57965E-05	0.00002

Table 7: Predictive and experimental values of enteric virus concentration at different depth.

Depth [M]	Predictive Values [Conc. [Mg/L]	Experimental Values [Conc. Mg/L]
3	7.4514E-10	6E-10
6	1.49028E-09	1.2E-09
9	2.23542E-09	1.8E-09
12	2.98056E-09	2.4E-09
15	3.7257E-09	3E-09
18	4.47084E-09	3.6E-09
21	5.21598E-09	4.2E-09
24	5.96112E-09	4.8E-09
27	6.70626E-09	5.4E-09
30	7.4514E-09	6E-09
33	8.19654E-09	6.6E-09
36	8.94169E-09	7.2E-09
39	9.68683E-09	7.8E-09
42	1.0432E-08	8.4E-09
45	1.11771E-08	9E-09
48	1.19222E-08	9.6E-09
51	1.26674E-08	1.02E-08
54	1.34125E-08	1.08E-08
57	1.41577E-08	1.14E-08
60	1.49028E-08	0.000000012
63	1.56479E-08	1.26E-08
66	1.63931E-08	1.32E-08
69	1.71382E-08	1.38E-08
72	1.78834E-08	1.44E-08
75	1.86285E-08	0.000000015
78	1.93737E-08	1.56E-08
81	2.01188E-08	1.62E-08
84	2.08639E-08	1.68E-08
87	2.16091E-08	1.74E-08
90	2.23542E-08	0.000000018

93	2.30994E-08	1.86E-08
96	2.38445E-08	1.92E-08
100	2.4838E-08	0.00000002

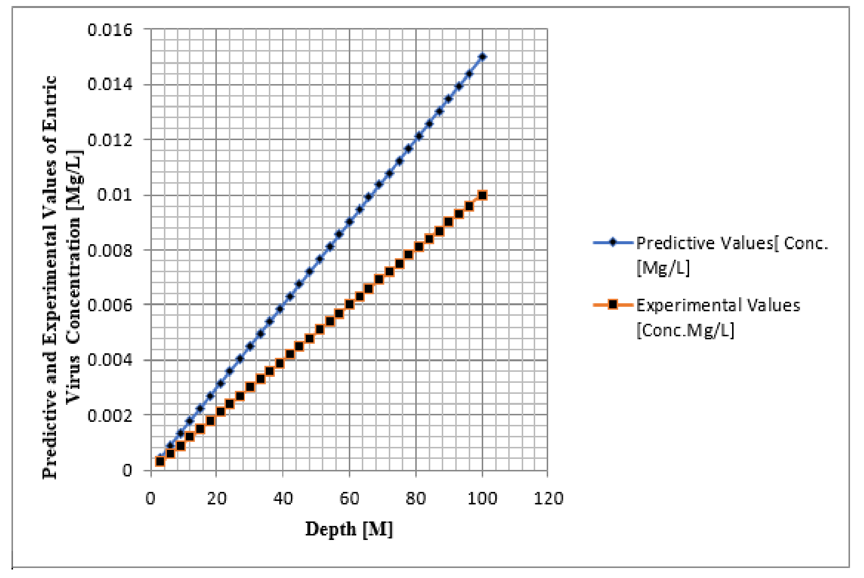

Figure 1: Predictive and experimental values of enteric virus concentration at different depth.

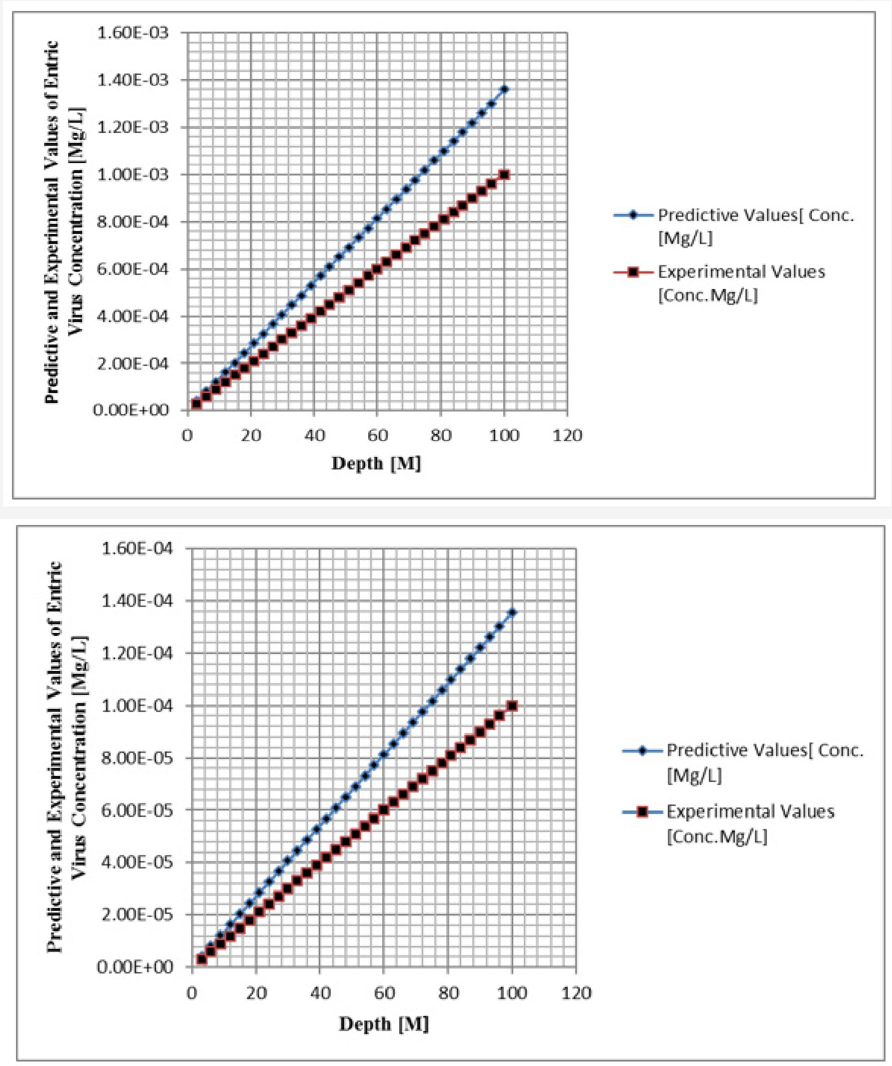

Figure 2: Predictive and experimental values of enteric virus concentration at different depth.

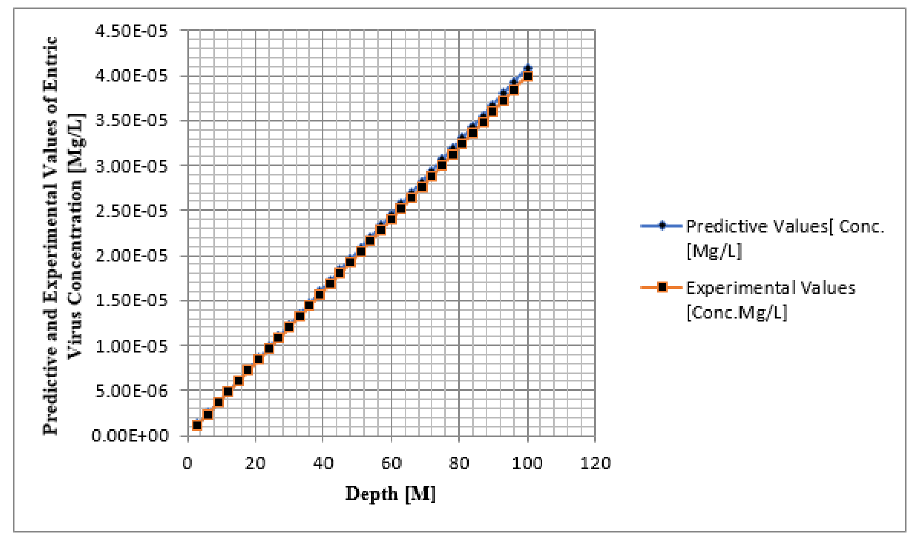

Figure 3: Predictive and experimental values of enteric virus concentration at different depth.

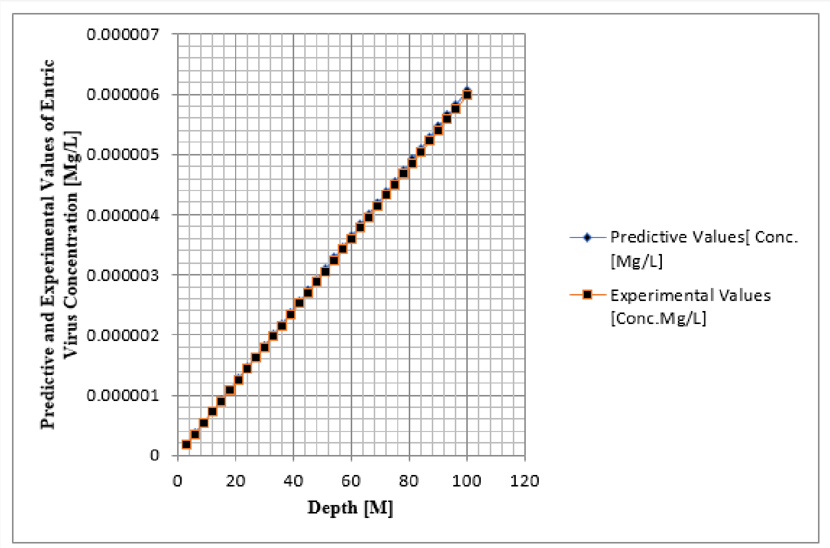

Figure 4: Predictive and experimental values of enteric virus concentration at different depth.

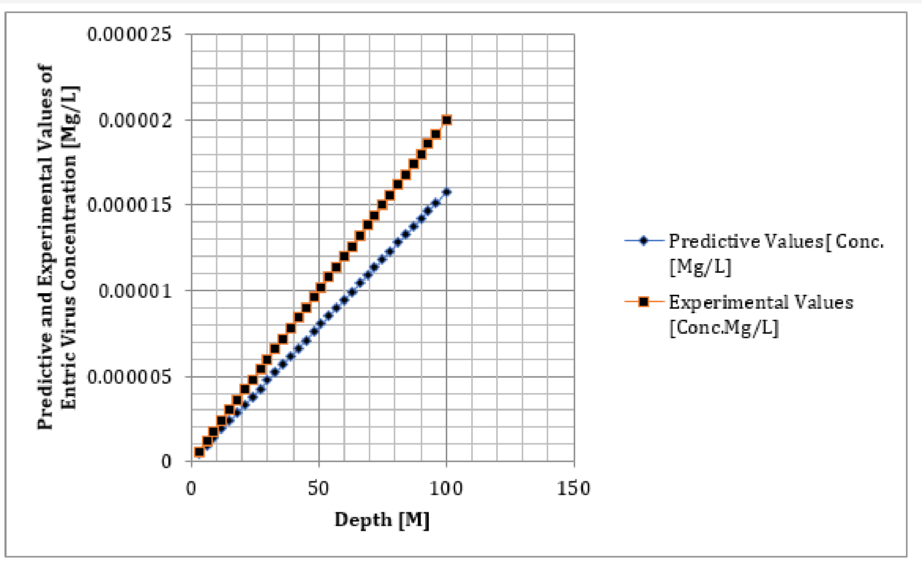

Figure 5: Predictive and experimental values of enteric virus concentration at different depth.

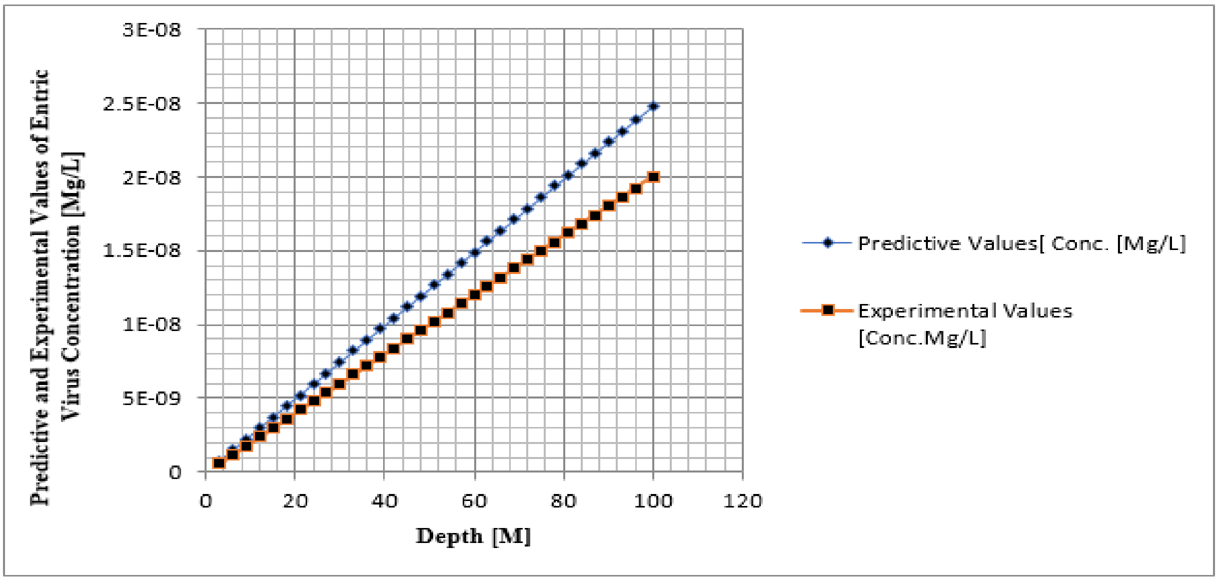

Figure 6: Predictive and experimental values of enteric virus concentration at different depth.

The study graphical representation from Figure 1-6 shows the behavior of the system in terms of the deposition of enteric virus and its transport process, linear trend were observed from the deposition of enteric virus in the coarse structural deposition, the study experienced linear exponential growth on the concentration of the contaminant, but the heterogeneity were not experienced on the rate of migration but through the variation of concentration in different location, the simulation values monitored the system in different conditions and find out that the concentration reduce with respect to variations of velocity of fluid flow in various location, these were expressed in different graphical representation, the concentration at various figures were heterogeneous, the study experienced the rate of transport process and observed influenced from velocity heterogeneous deposition in coarse formation, such condition also explained from the figure that the velocity of fluid transports contaminants reflect its behavior based on this factors in this stratum depositions. The study also observed other conditions such as microelement that may also express its positive impact on the contaminant by increasing their populations, the fluctuation of concentration are observed from variation of concentration from figure one at highest concentration in three meters, while the lowest concentration were experienced in figure six at three and hundred meters. Validation of simulation results were subject to experimental data and both parameters developed best fits correlation.

Conclusion

The study has monitored the system applying non-homogeneous system, this application was used to monitor the behavior of enteric virus in heterogeneous coarse deposition, this study developed this concept to adopt in deltaic and non-deltaic environment, and the derived model generated the applied techniques to predict the heterogeneous velocity of flow influence on the migration of enteric virus in heterogeneous coarse formation. The study express variation of velocity influenced on concentration of enteric virus in different simulation , these are where the concentrate growth rate determined the rate of velocity deposition in heterogeneous coarse formation, linear trend were experienced to the optimum value, but the concentration are not homogeneous due to fluctuation influenced from velocity of flow, the study observed linear condition on the trend, but the actual concentration are not linear, the optimum concentration are based on the lowest velocity of flow were accumulation of contaminant are experienced in the formation. This implies that the velocity of flow from the research study reflect the rate of enteric virus contamination in different depositions.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

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