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Predictive Model to Monitor the Rate of Dissolved Calcium Influenced by Void Ratio in Coarse Bed Formation in Coastal Area of Amadi-Ama Area of Rivers State

Eluozo Solomon Ndubuisi, Ekeleme Anthony Chibuzo

Department Civil Engineering, Gregory University, Shawnee, Nigeria

Email address:
Soloeluozo2013@hotmail.com (E. S. Ndubuisi)

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Abstract: This paper investigate the rate of dissolved calcium deposition in fine and coarse formation, the study is to monitor the rate of dissolved calcium content at different lithostratgraphy in the study location. Homogeneous fine and coarse formation were observed to deposit in the study location, organic soil were insignificant since the formation deposited slight quantity, the study observed predominant homogeneous fine and coarse soil strata, the permeability and porosity deposition were at high rate in various formation, the reflection of porosity and permeability were experienced on decreasing rate of dissolved calcium to phreatic beds. To monitor the deposition of dissolved calcium, the developed model expressed simulation values that were compared with experimental values, and both parameters express best fits validating the developed model. Experts will definitely apply the concept as a useful tool in monitoring and evaluation of dissolved calcium in unconfined beds.

Keywords: Predictive Model, Dissolved Nitrogen, Silty and Grave Bed

1. Introduction

Most pollution source of Groundwater are nitrate (NO_3^-) this has been observed to be ever-increasing speedily with extraordinarily sources due to high industrialization, urbanization including agricultural development with its other manmade activities, these conditions has pose high influences on groundwater resources pollution [8] numerous researchers has express these sources in various ways thus generating different solution in managing these sources of groundwater contaminant.[6, 7] have identified the overuse of nitrogen (N) fertilizer to be one of the main sources for groundwater nitrate. It is often associated with intensive farming. [2, 3, 4, 5, 6, 9 and 10]. But for this study the study are looking the nitrogen transports under the influences of unconsolidation rate of the soil formation precisely void ratio [10, 11]

2. Governing Equation

$$\frac{dA)t)}{dt} = C_1 r_1 - C_2(t) r_2 \tag{1}$$

Where

$$C_2(t) = \frac{Amount\ of\ Dissolved\ Nitrogen\ at\ anytime}{quantity\ of\ Dissolved\ Nirogenat\ anytime}$$

$$C_2(t) = \frac{A(t)}{quantity\ of\ Dissolved\ Nitrogen\ at\ anytime}$$

Therefore the amount of Nitrogen deposited at any time t = initial quantity of Nitrogen + quantity migrating from silty to gravel bed – quantity of Nitrogen living, the formation.

$$C_2(t) = \frac{A(t)}{V_o + r_t t - r_2 t} \tag{2a}$$

$$C_2(t)=1\ \frac{A(t)}{V_o - t\ (r_t - r_2)} \tag{2b}$$

Substituting the value of $C_2(t)$into (2) we have

$$\frac{dA(t)}{dt} = C_1 r_1 - \left[\frac{A(t)}{V_o + t(r - r_{21}}\right] r_2$$

$$A_{(o)}=A_t \tag{3a}$$

Since the rate of inflow=rate of outflow
i.e. $R_1=R_2$ given
$\rightarrow R_1=R_2=0$

$$\frac{dA(t)}{dt} = C_1 r_1 - \left(\frac{A}{V_o}\right) r_2 \tag{3b}$$

$$dA(t) = \left[C_1 r_1 - \left(\frac{A}{V_o}\right) r_2\right] dt \tag{4}$$

$$\int dA(t) = \int \left[C_1 r_1 - \left(\frac{A}{V_o}\right) r_2\right] dt \tag{5}$$

$$A(t) = \int C_1 r_1\, dt - - \left(\frac{A}{V_o}\right) r \frac{dt}{t} + k \tag{6}$$

$$A(t) = C_1 r_1 t - - \left(\frac{A}{V_o}\right) r_2 t + k \tag{7}$$

If= $\frac{d}{v}$

$$A(t) = C_1 r_1 \frac{d}{v} - - \left(\frac{A}{V_o}\right) r_2 \frac{d}{v} + k \tag{8}$$

3. Materials and Method

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

4. Results and Discussion

Results and discussion are presented in tables including graphical representation for calcium concentration in fine and coarse phreatic bed.

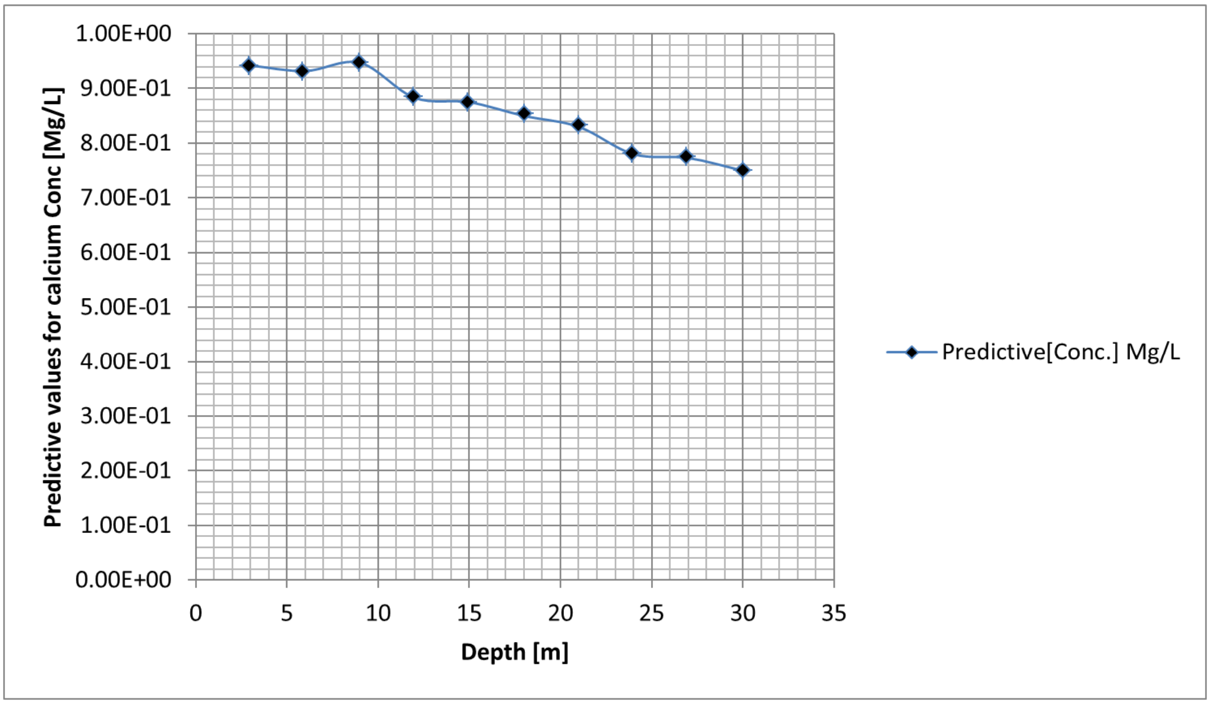

Figure 1. *Predictive Values of Calcium Concentration at Different Depth.*

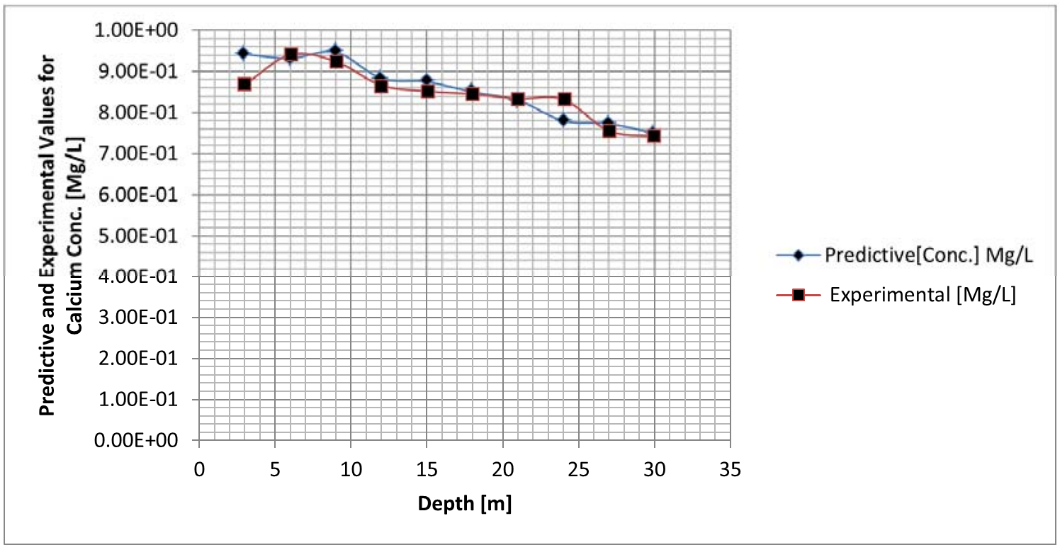

Figure 2. Predicted and Experimental Values of Calcium at Different Depth.

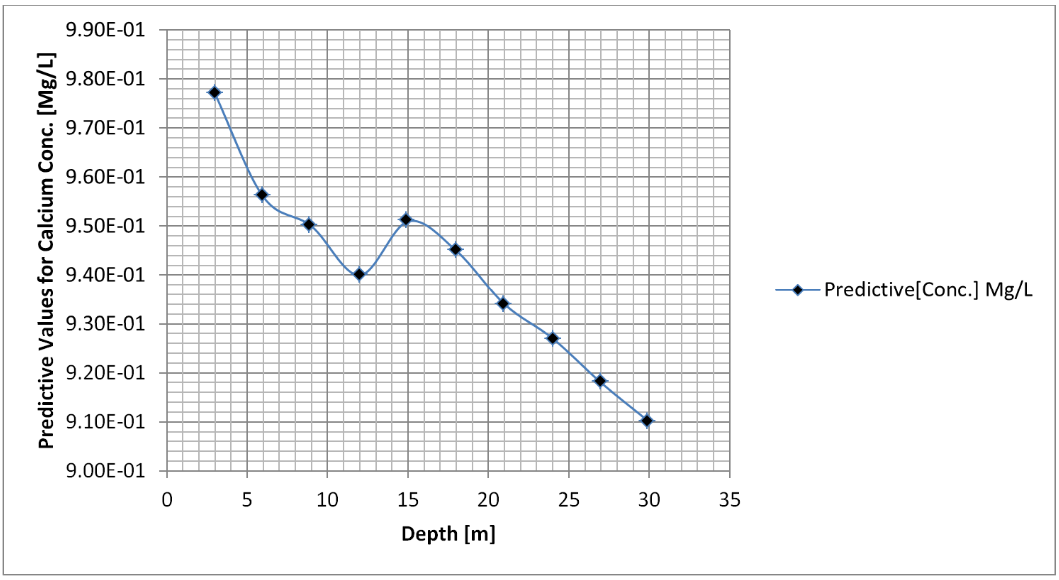

Figure 3. Predictive Values of Calcium Concentration at Different Depth.

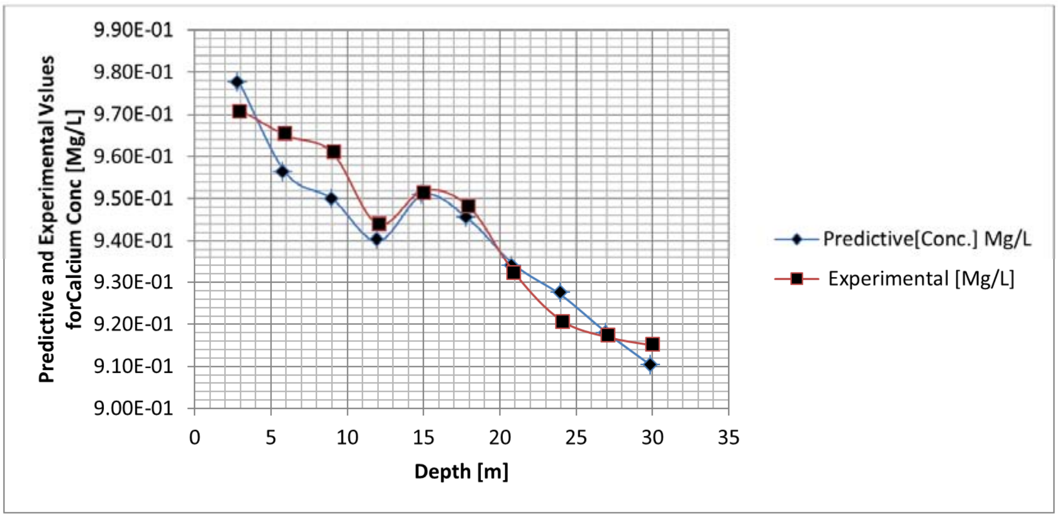

Figure 4. Predicted and Experimental Values of Calcium at Different Depth.

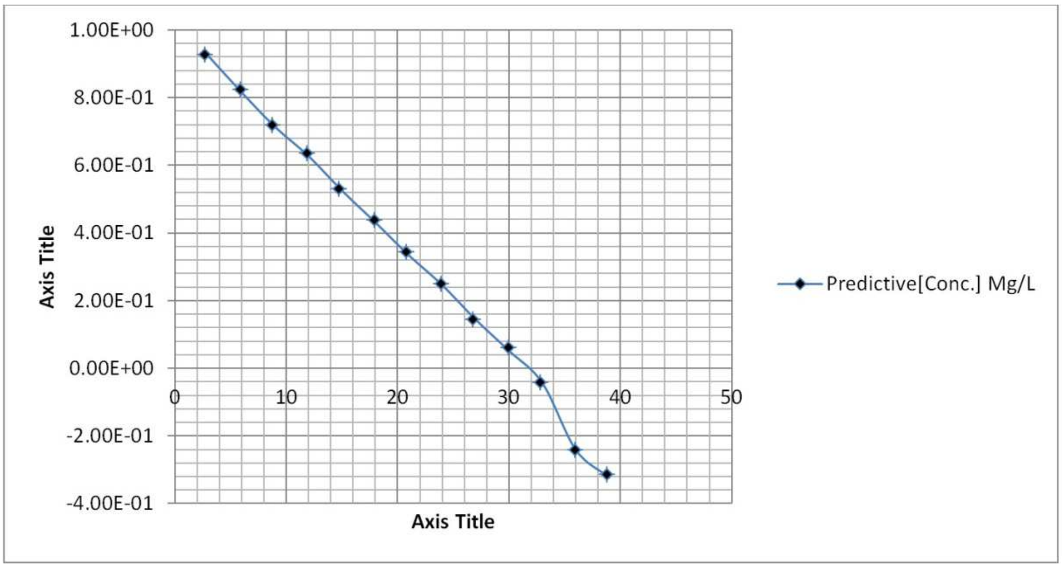

Figure 5. *Predictive Values of Calcium Concentration at Different Depth.*

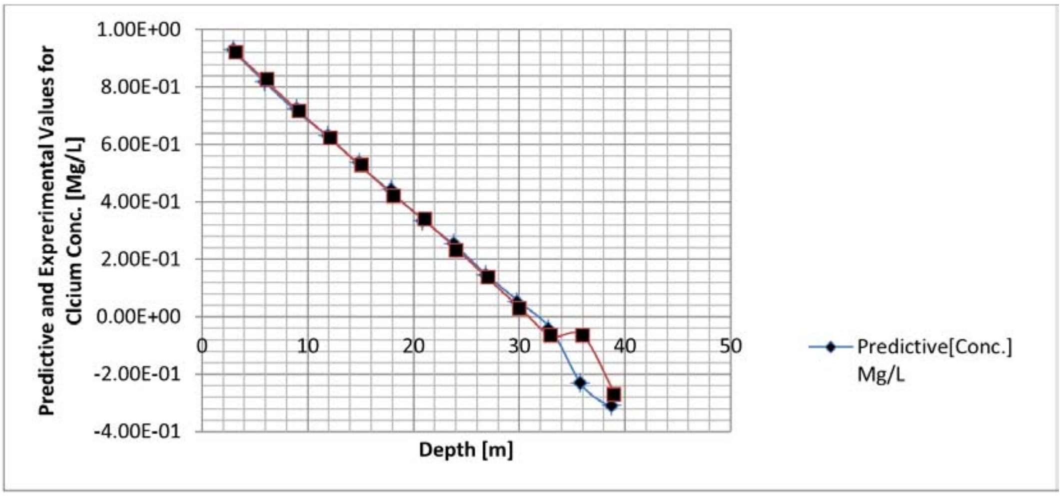

Figure 6. *Predicted and Experimental Values of Calcium at Different Depth.*

Table 1. *Predictive Values of calcium Concentration at Different Depth.*

Depth [M]	Predictive[Conc.] Mg/L
3	9.42E-01
6	9.32E-01
9	9.47E-01
12	8.83E-01
15	8.75E-01
18	8.50E-01
21	8.30E-01
24	7.80E-01
27	7.73E-01
30	7.50E-01

Table 2. *Predicted and Experimental Values of calcium at Different Depth.*

Depth [M]	Predictive[Conc.] Mg/L	Experimental [Mg/L]
3	9.42E-01	0.568
6	9.32E-01	0.941
9	9.47E-01	0.924
12	8.83E-01	0.866
15	8.75E-01	0.852
18	8.50E-01	0.845
21	8.30E-01	0.834
24	7.80E-01	0.832
27	7.73E-01	0.755
30	7.50E-01	0.742

Table 3. *Predictive Values of calcium Concentration at Different Depth.*

Depth [M]	Predictive[Conc.] Mg/L
3	9.77E-01
6	9.56E-01
9	9.50E-01
12	9.40E-01
15	9.51E-01
18	9.45E-01
21	9.34E-01
24	9.27E-01
27	9.18E-01
30	9.10E-01

Table 4. *Predicted and Experimental Values calcium at Different Depth.*

Depth [M]	Predictive[Conc.] Mg/L	Experimental [Mg/L]
3	9.77E-01	0.971
6	9.56E-01	0.965
9	9.50E-01	0.961
12	9.40E-01	0.944
15	9.51E-01	0.952
18	9.45E-01	0.948
21	9.34E-01	0.932
24	9.27E-01	0.921
27	9.18E-01	0.917
30	9.10E-01	0.915

Table 5. *Predictive Values of calcium Concentration at Different Depth.*

Depth [M]	Predictive[Conc.] Mg/L
3	9.23E-01
6	8.15E-01
9	7.13E-01
12	6.27E-01
15	5.25E-01
18	4.31E-01
21	3.34E-01
24	2.46E-01
27	1.44E-01
30	5.17E-02
33	-4.38E-02
36	-2.41E-01
39	-3.23E-01

Table 6. *Predicted and Experimental Values of calcium at Different Depth.*

Depth [M]	Predictive[Conc.] Mg/L	Experimental [Mg/L]
3	9.23E-01	9.26E-01
6	8.15E-01	8.23E-01
9	7.13E-01	7.21E-01
12	6.27E-01	6.24E-01
15	5.25E-01	5.25E-01
18	4.31E-01	4.27E-01
21	3.34E-01	3.37E-01
24	2.46E-01	2.39E-01
27	1.44E-01	1.35E-01
30	5.17E-02	3.42E-02
33	-4.38E-02	-6.52E-02
36	-2.41E-01	-6.53E-02
39	-3.23E-01	-2.65E-01

Figure one and two shows the rate of calcium degradation concentration from three to the minimum level at thirty metres, the rate of degradation in its concentration were observed to be reflected on the rate of unconsolidation of the formation at different strata, the degradation of the substances were as a result of high degree of permeability through porosity in some deposited formation. The predictive and experimental values express best fits, figure three and four developed similar condition in terms of decrease in concentration, rapid decrease were experiences from the optimum at three meter to the minimum at thirty metres, the theoretical and experimental values developed best fits comparing both parameters, figure five and six express the same state in degradation, the deposition of calcium were experienced at three metres, the optimum values are based on low deposition of permeability and porosity in the organic soil formation, the rate of calcium experienced decrease in fine and coarse deposition due to slight decrease in degree of void ratio, there rate of increase were observed in the study area since there is no inhibited minerals that should have decrease the concentration. Moreso the formation may have influence the degradation since there is no heterogeneous deposition in such porous formation, however, it observed non accumulation in phreatic depositions, and the expression shows that at phreatic bed, the mineral has decrease to be the concentration that is harmless to human health. Both parameters express best fits.

5. Conclusion

The depositions of calcium in fine and coarse formation were monitored to predict various rate of degradation to phreatic beds. The developed model generated simulation values from high to low concentration, the study shows the rate of dissolved substance at different formation, the developed model has express the concentration rates at different strata, such deposition from the graphical representation express the rate of calcium to phreatic bed, it observed the high rate of calcium deposition as a results of other source from manmade activities, these has generated lots of calcium substances in the soil, mismanagement of these chimerical for useful purpose developed lots of groundwater pollution in the study area, the degree of permeability and porosity in soil cause the accumulation in organic deposition, such condition increase the concentration rate of dissolved substances to phreatic aquifers, the developed model will definitely be a useful tools in monitoring and evaluation of dissolved calcium to phreatic aquifers.

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