TRANSPORT MODEL AND SIMULATION OF SULPHUR IN HETEROGENEOUS SILTY CLAY IN WETLAND ENVIRONMENT

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Abstract

The deposition of sulphur was monitored in different phases based on conditions as stated and observed in the study environment, the system monitored the conditions of the transport process thorough investigations carried out. The study detailed the behaviour of sulphur deposition in the soil, taking into account its formation characteristics that influence the migration rates of sulphur in a wetland environment. The study allowed for thorough investigation in order to generated the exact conditions of the formations in terms of sulphur depositions in the environment. The observations made was integrated in the study objective and the results generated, were used to consider the transport and depositions process of sulphur and its adverse effects in terms of soil on plant. It was further observed via the study, the reactions of sulphur deposition in which contributes to acidification as it was observed that there was a fall in the P^h as a result of sulphur contamination. An increase of phytotoxic aluminium contamination was observed as a loss of Ca2+ and Mg2+ ions were recorded through leaching. The negative impact which was observed from values generated at different points, were based on the significant parameters whose impacts were monitored in the transport process. The concept of simulation generated values that predominantly exhibited decreases with respect to increase in depth within 0.1-3m. The predictive values were compared with experimental data and both parameters developed a positive correlation. A detailed significant impact on soil pollution was observed using some environmental factors and formation characteristics in the study environment.

Keywords: Transport sulphur Heterogeneous, Silty Clay and Environment

1. Introduction

Several studies have been carried out on how pathogens survive longer in conditions when they are attached to solid particles (Gordon and Toze, 2003; Gerba, 2005; John and Rose, 2005). These studies reported a number of pathogens in sediment that was observed in several folds (10–1,000

times), these are much higher than in water by itself. During high flow velocity discharge, pathogens were observed to attach to sediment particles, and was released from the streambed into the water. Anderson et al. (2005) such condition were compared at differential survival of fecal bacteria in subtropical waters and sediment, it was also concluded that the decay rate of fecal coliform are attached to sediment, these are much lower in the sediment compared to water column; similar research studies results were reported by other experts such as (Gerba and McLeod, 1976; Fish and Pettibone, 1995; Craig, Fallow field et al., 2004) Pang et al. (2004) applied modelling to evaluate reversible and irreversible attachment of *E. coli* with solid particles, including that of attachment's impact on survival. Numerous viruses were observed to attach with iron oxide particles, this reduces the rate of inactivation (Ryan et al., 2002). The interactions of microbes from soil to ground water phreatic bed are based on the micronutrient. These microelements became substrate utilization to microbial population. Another study of virus carried out on transport through ground water explained that, pathogens transport is governed by particle. From different studies it was discovered that infectious diseases caused by pathogens are the third leading cause of death in the United States. In the past two decades, studies have reviled the emergence of several new pathogenic infectious diseases (Daszak et al., 2000). A large number of these diseases are caused by anthropogenic changes such as water resource development, it also includes climate warming, and interaction between human and animals (Krause, 1994; Epstein, 2001; Woolhouse, 2002; Foley et al., 2005; Jablasone et al., 2005; Fenwick, 2006; Normile, 2009; Schriewer, et al., 2010 Pramod 2012).

2. Theoretical Background

$$\frac{dC}{dX} + B(X)C_0K = A(X) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Nomenclature
C= Concentration
K= Velocities/ Permeability's Coefficients
C_0 **= Porosity and Void Ratio**
B = bacterial transport Coefficients/ Specific gravity
A= Constant

Multiplying (1) Through by P(x)

$$P(x)\frac{dC}{dx} + B(x)C_0KP(x) = A(x)P(x) \text{ ……..} \quad (2)$$

Let $P^1 = B(x)CKP(x) = A(x)P(x)$ (2^{nd}Term LHS)

$$\mathrm{P(x)}\frac{dC}{dx} + P^1(x)C_0K = A(x)P(x)$$

$$\frac{dC}{dx}(C_0PK) = A(x)P(x)$$

$$\mathrm{C(x)\ P(x)\ K} = \int A(x)P(x)dx \text{ ……} \quad (3)$$

Similarly; Let $P(x) = A(x)C_0P(x)$

$$\mathrm{P(x)}\frac{dC}{dx} = A(x)C_0P(x) - B(x)C_0P(x)$$

$$\frac{dC}{dx} = A(x)C_0K - B(x)C_0K$$

$$\frac{dC}{dx} = C_0(A(x) - B(x)K)$$

$$\frac{dC}{C_0} = (A(x) - B(x)K)dx$$

Integrate both sides, gives:

$\mathrm{Inc.} = \mathrm{A(x)\text{-}B(x)\ K} + C_1$

$(\mathrm{C} = \mathrm{Dexp}\,(\mathrm{A}(x) - \mathrm{B}(x)\mathrm{K})x$

3. **Materials and method**

Standard laboratory experiments were performed to monitor the rate of Sulphur transport at different formations. The depositions of the strata were collected in sequences based on the structural deposition at different study areas. The samples collected at different locations generated variation of concentration at different depths through its pressure flow at the lower end of the column. The experimental results were applied and compared with theoretical values for model validation.

4. Results and Discussion

Results and discussion are presented in tables including graphical representation of heterogeneous depositions on Sulphur concentration at different depths.

Table 1: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.99244491	0.9868
0.11	0.991692548	0.98608
0.12	0.990940755	0.98536
0.13	0.990189533	0.98464
0.14	0.98943888	0.98392
0.15	0.988688797	0.9832
0.16	0.987939282	0.98248
0.17	0.987190335	0.98176
0.18	0.986441956	0.98104
0.19	0.985694144	0.98032
0.2	0.984946899	0.9796
0.21	0.984200221	0.97888
0.22	0.983454109	0.97816
0.23	0.982708562	0.97744
0.24	0.981963581	0.97672
0.25	0.981219164	0.976
0.26	0.980475312	0.97528
0.27	0.979732023	0.97456
0.28	0.978989298	0.97384
0.3	0.977505537	0.9724
0.31	0.9767645	0.97168
0.32	0.976024025	0.97096
0.33	0.975284111	0.97024
0.34	0.974544757	0.96952
0.35	0.973805965	0.9688

0.36	**0.973067732**	**0.96808**
0.37	**0.97233006**	**0.96736**
0.38	**0.971592946**	**0.96664**
0.39	**0.970856391**	**0.96592**
0.4	**0.970120395**	**0.9652**
0.41	**0.969384956**	**0.96448**
0.42	**0.968650075**	**0.96376**
0.43	**0.967915751**	**0.96304**
0.44	**0.967181984**	**0.96232**
0.55	**0.959147166**	**0.9544**
0.56	**0.958420046**	**0.95368**
0.57	**0.957693477**	**0.95296**
0.58	**0.95696746**	**0.95224**
0.59	**0.956241992**	**0.95152**
0.6	**0.955517075**	**0.9508**
0.61	**0.954792707**	**0.95008**
0.62	**0.954068888**	**0.94936**
0.63	**0.953345618**	**0.94864**
0.64	**0.952622896**	**0.94792**
0.65	**0.951900723**	**0.9472**
0.66	**0.951179096**	**0.94648**
0.67	**0.950458017**	**0.94576**
0.68	**0.949737484**	**0.94504**
0.69	**0.949017498**	**0.94432**
0.7	**0.948298057**	**0.9436**
0.71	**0.947579162**	**0.94288**
0.72	**0.946860812**	**0.94216**
0.73	**0.946143006**	**0.94144**
0.74	**0.945425745**	**0.94072**
0.75	**0.944709027**	**0.94**
0.79	**0.941847585**	**0.93712**
0.8	**0.94113358**	**0.9364**
0.81	**0.940420116**	**0.93568**
0.82	**0.939707193**	**0.93496**
0.83	**0.938994811**	**0.93424**
0.9	**0.934023231**	**0.9292**
0.91	**0.933315158**	**0.92848**
0.92	**0.932607621**	**0.92776**
0.93	**0.93190062**	**0.92704**
0.94	**0.931194156**	**0.92632**
0.95	**0.930488227**	**0.9256**

0.96	0.929782833	0.92488
0.97	0.929077974	0.92416
0.98	0.92837365	0.92344
1	0.926966602	0.922
1.2	0.91301288	0.9076
1.25	0.909557394	0.904
1.3	0.906114986	0.9004
1.35	0.902685606	0.8968
1.4	0.899269205	0.8932
1.5	0.892475146	0.886

Table 2: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.99244491	0.9868
0.11	0.991692548	0.98608
0.12	0.990940755	0.98536
0.13	0.990189533	0.98464
0.14	0.98943888	0.98392
0.15	0.988688797	0.9832
0.16	0.987939282	0.98248
0.17	0.987190335	0.98176
0.18	0.986441956	0.98104
0.19	0.985694144	0.98032
0.2	0.984946899	0.9796
0.21	0.984200221	0.97888
0.22	0.983454109	0.97816
0.23	0.982708562	0.97744
0.24	0.981963581	0.97672
0.25	0.981219164	0.976
0.26	0.980475312	0.97528
0.27	0.979732023	0.97456
0.28	0.978989298	0.97384
0.3	0.977505537	0.9724
0.31	0.9767645	0.97168
0.32	0.976024025	0.97096
0.33	0.975284111	0.97024
0.34	0.974544757	0.96952

0.35	**0.973805965**	**0.9688**
0.36	**0.973067732**	**0.96808**
0.37	**0.97233006**	**0.96736**
0.38	**0.971592946**	**0.96664**
0.39	**0.970856391**	**0.96592**
0.4	**0.970120395**	**0.9652**
0.41	**0.969384956**	**0.96448**
0.42	**0.968650075**	**0.96376**
0.43	**0.967915751**	**0.96304**
0.44	**0.967181984**	**0.96232**
0.55	**0.959147166**	**0.9544**
0.56	**0.958420046**	**0.95368**
0.57	**0.957693477**	**0.95296**
0.58	**0.95696746**	**0.95224**
0.59	**0.956241992**	**0.95152**
0.6	**0.955517075**	**0.9508**
0.61	**0.954792707**	**0.95008**
0.62	**0.954068888**	**0.94936**
0.63	**0.953345618**	**0.94864**
0.64	**0.952622896**	**0.94792**
0.65	**0.951900723**	**0.9472**
0.66	**0.951179096**	**0.94648**
0.67	**0.950458017**	**0.94576**
0.68	**0.949737484**	**0.94504**
0.69	**0.949017498**	**0.94432**
0.7	**0.948298057**	**0.9436**
0.71	**0.947579162**	**0.94288**
0.72	**0.946860812**	**0.94216**
0.73	**0.946143006**	**0.94144**
0.74	**0.945425745**	**0.94072**
0.75	**0.944709027**	**0.94**
0.79	**0.941847585**	**0.93712**
0.8	**0.94113358**	**0.9364**
0.81	**0.940420116**	**0.93568**
0.82	**0.939707193**	**0.93496**
0.83	**0.938994811**	**0.93424**
0.9	**0.934023231**	**0.9292**
0.91	**0.933315158**	**0.92848**
0.92	**0.932607621**	**0.92776**
0.93	**0.93190062**	**0.92704**
0.94	**0.931194156**	**0.92632**

0.95	0.930488227	0.9256
0.96	0.929782833	0.92488
0.97	0.929077974	0.92416
0.98	0.92837365	0.92344
1	0.926966602	0.922
1.12	0.918568984	0.91336
1.14	0.917176797	0.91192
1.16	0.915786719	0.91048
1.18	0.914398748	0.90904
1.2	0.91301288	0.9076
1.22	0.911629113	0.90616

Table 3: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.991539647	0.988
0.11	0.990697559	0.9872
0.12	0.989856186	0.9864
0.13	0.989015527	0.9856
0.14	0.988175582	0.9848
0.15	0.987336351	0.984
0.16	0.986497832	0.9832
0.17	0.985660025	0.9824
0.18	0.98482293	0.9816
0.19	0.983986546	0.9808
0.2	0.983150872	0.98
0.21	0.982315908	0.9792
0.22	0.981481653	0.9784
0.23	0.980648107	0.9776
0.24	0.979815268	0.9768
0.25	0.978983137	0.976
0.26	0.978151712	0.9752
0.27	0.977320994	0.9744
0.28	0.976490981	0.9736
0.3	0.974833069	0.972
0.31	0.974005169	0.9712
0.32	0.973177972	0.9704
0.33	0.972351478	0.9696

0.34	**0.971525685**	**0.9688**
0.35	**0.970700594**	**0.968**
0.36	**0.969876204**	**0.9672**
0.37	**0.969052514**	**0.9664**
0.38	**0.968229523**	**0.9656**
0.39	**0.967407231**	**0.9648**
0.4	**0.966585638**	**0.964**
0.41	**0.965764742**	**0.9632**
0.42	**0.964944543**	**0.9624**
0.43	**0.964125041**	**0.9616**
0.44	**0.963306235**	**0.9608**
0.55	**0.954345136**	**0.952**
0.56	**0.953534636**	**0.9512**
0.57	**0.952724824**	**0.9504**
0.58	**0.9519157**	**0.9496**
0.59	**0.951107263**	**0.9488**
0.6	**0.950299513**	**0.948**
0.61	**0.949492448**	**0.9472**
0.62	**0.948686069**	**0.9464**
0.63	**0.947880375**	**0.9456**
0.64	**0.947075366**	**0.9448**
0.65	**0.946271039**	**0.944**
0.66	**0.945467396**	**0.9432**
0.67	**0.944664436**	**0.9424**
0.68	**0.943862157**	**0.9416**
0.69	**0.94306056**	**0.9408**
0.7	**0.942259644**	**0.94**
0.71	**0.941459407**	**0.9392**
0.72	**0.940659851**	**0.9384**
0.73	**0.939860973**	**0.9376**
0.74	**0.939062774**	**0.9368**
0.75	**0.938265253**	**0.936**
0.79	**0.935081935**	**0.9328**
0.8	**0.934287795**	**0.932**
0.81	**0.933494329**	**0.9312**
0.82	**0.932701537**	**0.9304**
0.83	**0.931909418**	**0.9296**
0.9	**0.926383391**	**0.924**
0.91	**0.925596638**	**0.9232**
0.92	**0.924810553**	**0.9224**
0.93	**0.924025136**	**0.9216**

0.94	0.923240385	0.9208
0.95	0.922456302	0.92
0.96	0.921672884	0.9192
0.97	0.920890131	0.9184
0.98	0.920108044	0.9176
1	0.91854586	0.916
1.2	0.903069164	0.9
1.25	0.899240908	0.896
1.3	0.89542888	0.892
1.35	0.891633012	0.888
1.4	0.887853236	0.884
1.5	0.880341685	0.876

Table 4: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.990777546	0.9853
0.11	0.989859991	0.98443
0.12	0.988943286	0.98356
0.13	0.988027431	0.98269
0.14	0.987112423	0.98182
0.15	0.986198263	0.98095
0.16	0.985284949	0.98008
0.17	0.984372481	0.97921
0.18	0.983460858	0.97834
0.19	0.98255008	0.97747
0.2	0.981640145	0.9766
0.21	0.980731052	0.97573
0.22	0.979822802	0.97486
0.23	0.978915393	0.97399
0.24	0.978008824	0.97312
0.25	0.977103094	0.97225
0.26	0.976198203	0.97138
0.27	0.975294151	0.97051
0.28	0.974390935	0.96964
0.3	0.972587013	0.9679
0.31	0.971686305	0.96703
0.32	0.970786431	0.96616

0.33	**0.96988739**	**0.96529**
0.34	**0.968989182**	**0.96442**
0.35	**0.968091805**	**0.96355**
0.36	**0.96719526**	**0.96268**
0.37	**0.966299545**	**0.96181**
0.38	**0.965404659**	**0.96094**
0.39	**0.964510603**	**0.96007**
0.4	**0.963617374**	**0.9592**
0.41	**0.962724972**	**0.95833**
0.42	**0.961833397**	**0.95746**
0.43	**0.960942648**	**0.95659**
0.44	**0.960052723**	**0.95572**
0.55	**0.95031778**	**0.94615**
0.56	**0.949437695**	**0.94528**
0.57	**0.948558425**	**0.94441**
0.58	**0.94767997**	**0.94354**
0.59	**0.946802328**	**0.94267**
0.6	**0.945925498**	**0.9418**
0.61	**0.945049481**	**0.94093**
0.62	**0.944174275**	**0.94006**
0.63	**0.94329988**	**0.93919**
0.64	**0.942426294**	**0.93832**
0.65	**0.941553518**	**0.93745**
0.66	**0.940681549**	**0.93658**
0.67	**0.939810388**	**0.93571**
0.68	**0.938940034**	**0.93484**
0.69	**0.938070486**	**0.93397**
0.7	**0.937201744**	**0.9331**
0.71	**0.936333805**	**0.93223**
0.72	**0.935466671**	**0.93136**
0.73	**0.93460034**	**0.93049**
0.74	**0.933734811**	**0.92962**
0.75	**0.932870083**	**0.92875**
0.79	**0.929419174**	**0.92527**
0.8	**0.928558443**	**0.9244**
0.81	**0.92769851**	**0.92353**
0.82	**0.926839372**	**0.92266**
0.83	**0.925981031**	**0.92179**
0.9	**0.919994855**	**0.9157**
0.91	**0.919142852**	**0.91483**
0.92	**0.918291638**	**0.91396**

0.93	**0.917441213**	**0.91309**
0.94	**0.916591575**	**0.91222**
0.95	**0.915742723**	**0.91135**
0.96	**0.914894658**	**0.91048**
0.97	**0.914047379**	**0.90961**
0.98	**0.913200884**	**0.90874**
1	**0.911510245**	**0.907**
1.12	**0.901431937**	**0.89656**
1.14	**0.899763086**	**0.89482**
1.16	**0.898097325**	**0.89308**
1.18	**0.896434648**	**0.89134**
1.2	**0.894775049**	**0.8896**
1.22	**0.893118522**	**0.88786**

Table 5: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	**0.991539647**	**0.988**
0.11	**0.990697559**	**0.9872**
0.12	**0.989856186**	**0.9864**
0.13	**0.989015527**	**0.9856**
0.14	**0.988175582**	**0.9848**
0.15	**0.987336351**	**0.984**
0.16	**0.986497832**	**0.9832**
0.17	**0.985660025**	**0.9824**
0.18	**0.98482293**	**0.9816**
0.19	**0.983986546**	**0.9808**
0.2	**0.983150872**	**0.98**
0.21	**0.982315908**	**0.9792**
0.22	**0.981481653**	**0.9784**
0.23	**0.980648107**	**0.9776**
0.24	**0.979815268**	**0.9768**
0.25	**0.978983137**	**0.976**
0.26	**0.978151712**	**0.9752**
0.27	**0.977320994**	**0.9744**
0.28	**0.976490981**	**0.9736**
0.3	**0.974833069**	**0.972**
0.31	**0.974005169**	**0.9712**

0.32	**0.973177972**	**0.9704**
0.33	**0.972351478**	**0.9696**
0.34	**0.971525685**	**0.9688**
0.35	**0.970700594**	**0.968**
0.36	**0.969876204**	**0.9672**
0.37	**0.969052514**	**0.9664**
0.38	**0.968229523**	**0.9656**
0.39	**0.967407231**	**0.9648**
0.4	**0.966585638**	**0.964**
0.41	**0.965764742**	**0.9632**
0.42	**0.964944543**	**0.9624**
0.43	**0.964125041**	**0.9616**
0.44	**0.963306235**	**0.9608**
0.55	**0.954345136**	**0.952**
0.56	**0.953534636**	**0.9512**
0.57	**0.952724824**	**0.9504**
0.58	**0.9519157**	**0.9496**
0.59	**0.951107263**	**0.9488**
0.6	**0.950299513**	**0.948**
0.61	**0.949492448**	**0.9472**
0.62	**0.948686069**	**0.9464**
0.63	**0.947880375**	**0.9456**
0.64	**0.947075366**	**0.9448**
0.65	**0.946271039**	**0.944**
0.66	**0.945467396**	**0.9432**
0.67	**0.944664436**	**0.9424**
0.68	**0.943862157**	**0.9416**
0.69	**0.94306056**	**0.9408**
0.7	**0.942259644**	**0.94**
0.71	**0.941459407**	**0.9392**
0.72	**0.940659851**	**0.9384**
0.73	**0.939860973**	**0.9376**
0.74	**0.939062774**	**0.9368**
0.75	**0.938265253**	**0.936**
0.79	**0.935081935**	**0.9328**
0.8	**0.934287795**	**0.932**
0.81	**0.933494329**	**0.9312**
0.82	**0.932701537**	**0.9304**
0.83	**0.931909418**	**0.9296**
0.9	**0.926383391**	**0.924**
0.91	**0.925596638**	**0.9232**

0.92	0.924810553	0.9224
0.93	0.924025136	0.9216
0.94	0.923240385	0.9208
0.95	0.922456302	0.92
0.96	0.921672884	0.9192
0.97	0.920890131	0.9184
0.98	0.920108044	0.9176
1	0.91854586	0.916
1.12	0.909228302	0.9064
1.14	0.90768459	0.9048
1.16	0.9061435	0.9032
1.18	0.904605026	0.9016
1.2	0.903069164	0.9
1.22	0.90153591	0.8984

Table 6: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.990777546	0.9853
0.11	0.989859991	0.98443
0.12	0.988943286	0.98356
0.13	0.988027431	0.98269
0.14	0.987112423	0.98182
0.15	0.986198263	0.98095
0.16	0.985284949	0.98008
0.17	0.984372481	0.97921
0.18	0.983460858	0.97834
0.19	0.98255008	0.97747
0.2	0.981640145	0.9766
0.21	0.980731052	0.97573
0.22	0.979822802	0.97486
0.23	0.978915393	0.97399
0.24	0.978008824	0.97312
0.25	0.977103094	0.97225
0.26	0.976198203	0.97138
0.27	0.975294151	0.97051
0.28	0.974390935	0.96964
0.3	0.972587013	0.9679

0.31	**0.971686305**	**0.96703**
0.32	**0.970786431**	**0.96616**
0.33	**0.96988739**	**0.96529**
0.34	**0.968989182**	**0.96442**
0.35	**0.968091805**	**0.96355**
0.36	**0.96719526**	**0.96268**
0.37	**0.966299545**	**0.96181**
0.38	**0.965404659**	**0.96094**
0.39	**0.964510603**	**0.96007**
0.4	**0.963617374**	**0.9592**
0.41	**0.962724972**	**0.95833**
0.42	**0.961833397**	**0.95746**
0.43	**0.960942648**	**0.95659**
0.44	**0.960052723**	**0.95572**
0.55	**0.95031778**	**0.94615**
0.56	**0.949437695**	**0.94528**
0.57	**0.948558425**	**0.94441**
0.58	**0.94767997**	**0.94354**
0.59	**0.946802328**	**0.94267**
0.6	**0.945925498**	**0.9418**
0.61	**0.945049481**	**0.94093**
0.62	**0.944174275**	**0.94006**
0.63	**0.94329988**	**0.93919**
0.64	**0.942426294**	**0.93832**
0.65	**0.941553518**	**0.93745**
0.66	**0.940681549**	**0.93658**
0.67	**0.939810388**	**0.93571**
0.68	**0.938940034**	**0.93484**
0.69	**0.938070486**	**0.93397**
0.7	**0.937201744**	**0.9331**
0.71	**0.936333805**	**0.93223**
0.72	**0.935466671**	**0.93136**
0.73	**0.93460034**	**0.93049**
0.74	**0.933734811**	**0.92962**
0.75	**0.932870083**	**0.92875**
0.79	**0.929419174**	**0.92527**
0.8	**0.928558443**	**0.9244**
0.81	**0.92769851**	**0.92353**
0.82	**0.926839372**	**0.92266**
0.83	**0.925981031**	**0.92179**
0.9	**0.919994855**	**0.9157**

0.91	0.919142852	0.91483
0.92	0.918291638	0.91396
0.93	0.917441213	0.91309
0.94	0.916591575	0.91222
0.95	0.915742723	0.91135
0.96	0.914894658	0.91048
0.97	0.914047379	0.90961
0.98	0.913200884	0.90874
1	0.911510245	0.907
1.2	0.894775049	0.8896
1.25	0.89063948	0.88525
1.3	0.886523026	0.8809
1.35	0.882425598	0.87655
1.4	0.878347108	0.8722
1.5	0.870246592	0.8635

Table 7: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.991175019	0.9867
0.11	0.990296816	0.98587
0.12	0.989419391	0.98504
0.13	0.988542743	0.98421
0.14	0.987666872	0.98338
0.15	0.986791777	0.98255
0.16	0.985917457	0.98172
0.17	0.985043912	0.98089
0.18	0.984171141	0.98006
0.19	0.983299143	0.97923
0.2	0.982427918	0.9784
0.21	0.981557465	0.97757
0.22	0.980687783	0.97674
0.23	0.979818872	0.97591
0.24	0.97895073	0.97508
0.25	0.978083358	0.97425
0.26	0.977216754	0.97342
0.27	0.976350918	0.97259
0.28	0.97548585	0.97176

0.3	**0.973758011**	**0.9701**
0.31	**0.972895239**	**0.96927**
0.32	**0.972033232**	**0.96844**
0.33	**0.971171989**	**0.96761**
0.34	**0.970311509**	**0.96678**
0.35	**0.969451791**	**0.96595**
0.36	**0.968592835**	**0.96512**
0.37	**0.96773464**	**0.96429**
0.38	**0.966877206**	**0.96346**
0.39	**0.966020531**	**0.96263**
0.4	**0.965164615**	**0.9618**
0.41	**0.964309457**	**0.96097**
0.42	**0.963455058**	**0.96014**
0.43	**0.962601415**	**0.95931**
0.44	**0.961748528**	**0.95848**
0.55	**0.952416505**	**0.94935**
0.56	**0.951572643**	**0.94852**
0.57	**0.950729528**	**0.94769**
0.58	**0.94988716**	**0.94686**
0.59	**0.949045539**	**0.94603**
0.6	**0.948204663**	**0.9452**
0.61	**0.947364533**	**0.94437**
0.62	**0.946525147**	**0.94354**
0.63	**0.945686504**	**0.94271**
0.64	**0.944848605**	**0.94188**
0.65	**0.944011448**	**0.94105**
0.66	**0.943175032**	**0.94022**
0.67	**0.942339358**	**0.93939**
0.68	**0.941504424**	**0.93856**
0.69	**0.94067023**	**0.93773**
0.7	**0.939836775**	**0.9369**
0.71	**0.939004059**	**0.93607**
0.72	**0.93817208**	**0.93524**
0.73	**0.937340839**	**0.93441**
0.74	**0.936510334**	**0.93358**
0.75	**0.935680565**	**0.93275**
0.79	**0.932368833**	**0.92943**
0.8	**0.931542734**	**0.9286**
0.81	**0.930717366**	**0.92777**
0.82	**0.929892729**	**0.92694**
0.83	**0.929068824**	**0.92611**

0.9	**0.923321887**	**0.9203**
0.91	**0.922503803**	**0.91947**
0.92	**0.921686444**	**0.91864**
0.93	**0.920869809**	**0.91781**
0.94	**0.920053898**	**0.91698**
0.95	**0.919238709**	**0.91615**
0.96	**0.918424243**	**0.91532**
0.97	**0.917610499**	**0.91449**
0.98	**0.916797475**	**0.91366**
1	**0.915173589**	**0.912**
1.12	**0.905490494**	**0.90204**
1.14	**0.903886636**	**0.90038**
1.16	**0.902285617**	**0.89872**
1.18	**0.900687435**	**0.89706**
1.2	**0.899092084**	**0.8954**
1.22	**0.897499558**	**0.89374**

Table 8: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.2	**0.982427918**	**0.9784**
0.22	**0.980687783**	**0.97674**
0.24	**0.97895073**	**0.97508**
0.26	**0.977216754**	**0.97342**
0.28	**0.97548585**	**0.97176**
3	**0.766496956**	**0.746**
0.32	**0.972033232**	**0.96844**
0.34	**0.970311509**	**0.96678**
0.36	**0.968592835**	**0.96512**
0.38	**0.966877206**	**0.96346**
0.4	**0.965164615**	**0.9618**
0.42	**0.963455058**	**0.96014**
0.44	**0.961748528**	**0.95848**
0.46	**0.960045022**	**0.95682**
0.48	**0.958344533**	**0.95516**
0.5	**0.956647055**	**0.9535**
0.52	**0.954952585**	**0.95184**
0.54	**0.953261116**	**0.95018**

0.56	**0.951572643**	**0.94852**
0.58	**0.94988716**	**0.94686**
0.6	**0.948204663**	**0.9452**
0.62	**0.946525147**	**0.94354**
0.64	**0.944848605**	**0.94188**
0.66	**0.943175032**	**0.94022**
0.68	**0.941504424**	**0.93856**
0.7	**0.939836775**	**0.9369**
0.72	**0.93817208**	**0.93524**
0.74	**0.936510334**	**0.93358**
0.76	**0.934851531**	**0.93192**
0.78	**0.933195666**	**0.93026**
0.82	**0.929892729**	**0.92694**
0.84	**0.928245648**	**0.92528**
0.86	**0.926601484**	**0.92362**
0.88	**0.924960232**	**0.92196**
0.9	**0.923321887**	**0.9203**
0.92	**0.921686444**	**0.91864**
0.94	**0.920053898**	**0.91698**
0.96	**0.918424243**	**0.91532**
0.98	**0.916797475**	**0.91366**
1	**0.915173589**	**0.912**
1.12	**0.905490494**	**0.90204**
1.14	**0.903886636**	**0.90038**
1.16	**0.902285617**	**0.89872**
1.18	**0.900687435**	**0.89706**
1.2	**0.899092084**	**0.8954**
1.22	**0.897499558**	**0.89374**
1.24	**0.895909853**	**0.89208**
1.26	**0.894322964**	**0.89042**
1.28	**0.892738886**	**0.88876**
2	**0.837542698**	**0.829**
2.22	**0.821367891**	**0.81074**
2.24	**0.819913036**	**0.80908**
2.26	**0.818460757**	**0.80742**
2.28	**0.81701105**	**0.80576**
3	**0.766496956**	**0.746**

Table 9: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.991175019	0.9867
0.12	0.989419391	0.98504
0.14	0.987666872	0.98338
0.15	0.986791777	0.98255
0.16	0.985917457	0.98172
0.17	0.985043912	0.98089
0.18	0.984171141	0.98006
0.19	0.983299143	0.97923
0.21	0.981557465	0.97757
2.22	0.821367891	0.81074
0.23	0.979818872	0.97591
0.24	0.97895073	0.97508
0.25	0.978083358	0.97425
0.26	0.977216754	0.97342
0.27	0.976350918	0.97259
0.28	0.97548585	0.97176
0.29	0.974621547	0.97093
0.3	0.973758011	0.9701
0.31	0.972895239	0.96927
0.32	0.972033232	0.96844
0.33	0.971171989	0.96761
0.34	0.970311509	0.96678
0.35	0.969451791	0.96595
0.36	0.968592835	0.96512
0.37	0.96773464	0.96429
0.38	0.966877206	0.96346
0.39	0.966020531	0.96263
0.4	0.965164615	0.9618
0.41	0.964309457	0.96097
0.42	0.963455058	0.96014
0.43	0.962601415	0.95931
0.44	0.961748528	0.95848
0.45	0.960896398	0.95765
0.46	0.960045022	0.95682
0.47	0.9591944	0.95599
0.48	0.958344533	0.95516
0.49	0.957495418	0.95433
0.5	0.956647055	0.9535

0.51	**0.955799445**	**0.95267**
0.52	**0.954952585**	**0.95184**
0.53	**0.954106476**	**0.95101**
0.56	**0.951572643**	**0.94852**
0.57	**0.950729528**	**0.94769**
0.58	**0.94988716**	**0.94686**
0.59	**0.949045539**	**0.94603**
0.6	**0.948204663**	**0.9452**
0.61	**0.947364533**	**0.94437**
0.62	**0.946525147**	**0.94354**
0.63	**0.945686504**	**0.94271**
0.64	**0.944848605**	**0.94188**
0.65	**0.944011448**	**0.94105**
0.66	**0.943175032**	**0.94022**
0.67	**0.942339358**	**0.93939**
0.68	**0.941504424**	**0.93856**
0.69	**0.94067023**	**0.93773**
0.7	**0.939836775**	**0.9369**
0.71	**0.939004059**	**0.93607**
0.72	**0.93817208**	**0.93524**
0.73	**0.937340839**	**0.93441**
0.74	**0.936510334**	**0.93358**
0.75	**0.935680565**	**0.93275**
0.76	**0.934851531**	**0.93192**
0.77	**0.934023231**	**0.93109**
0.78	**0.933195666**	**0.93026**
0.79	**0.932368833**	**0.92943**
0.8	**0.931542734**	**0.9286**
0.81	**0.930717366**	**0.92777**
0.82	**0.929892729**	**0.92694**
0.83	**0.929068824**	**0.92611**
0.84	**0.928245648**	**0.92528**
0.85	**0.927423201**	**0.92445**
0.86	**0.926601484**	**0.92362**
0.87	**0.925780494**	**0.92279**
0.88	**0.924960232**	**0.92196**
0.89	**0.924140696**	**0.92113**
0.9	**0.923321887**	**0.9203**

Table 10: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.1	0.991175019	0.9867
0.11	0.990296816	0.98587
0.12	0.989419391	0.98504
0.13	0.988542743	0.98421
0.14	0.987666872	0.98338
0.15	0.986791777	0.98255
0.16	0.985917457	0.98172
0.17	0.985043912	0.98089
0.18	0.984171141	0.98006
0.19	0.983299143	0.97923
0.2	0.982427918	0.9784
0.21	0.981557465	0.97757
0.22	0.980687783	0.97674
0.23	0.979818872	0.97591
0.24	0.97895073	0.97508
0.25	0.978083358	0.97425
0.26	0.977216754	0.97342
0.27	0.976350918	0.97259
0.28	0.97548585	0.97176
0.3	0.973758011	0.9701
0.31	0.972895239	0.96927
0.32	0.972033232	0.96844
0.33	0.971171989	0.96761
0.34	0.970311509	0.96678
0.35	0.969451791	0.96595
0.36	0.968592835	0.96512
0.37	0.96773464	0.96429
0.38	0.966877206	0.96346
0.39	0.966020531	0.96263
0.4	0.965164615	0.9618
0.41	0.964309457	0.96097
0.42	0.963455058	0.96014
0.43	0.962601415	0.95931
0.44	0.961748528	0.95848
0.55	0.952416505	0.94935
0.56	0.951572643	0.94852
0.57	0.950729528	0.94769
0.58	0.94988716	0.94686

0.59	**0.949045539**	**0.94603**
0.6	**0.948204663**	**0.9452**
0.61	**0.947364533**	**0.94437**
0.62	**0.946525147**	**0.94354**
0.63	**0.945686504**	**0.94271**
0.64	**0.944848605**	**0.94188**
0.65	**0.944011448**	**0.94105**
0.66	**0.943175032**	**0.94022**
0.67	**0.942339358**	**0.93939**
0.68	**0.941504424**	**0.93856**
0.69	**0.94067023**	**0.93773**
0.7	**0.939836775**	**0.9369**
0.71	**0.939004059**	**0.93607**
0.72	**0.93817208**	**0.93524**
0.73	**0.937340839**	**0.93441**
0.74	**0.936510334**	**0.93358**
0.75	**0.935680565**	**0.93275**
0.79	**0.932368833**	**0.92943**
0.8	**0.931542734**	**0.9286**
0.81	**0.930717366**	**0.92777**
0.82	**0.929892729**	**0.92694**
0.83	**0.929068824**	**0.92611**
0.9	**0.923321887**	**0.9203**
0.91	**0.922503803**	**0.91947**
0.92	**0.921686444**	**0.91864**
0.93	**0.920869809**	**0.91781**
0.94	**0.920053898**	**0.91698**
0.95	**0.919238709**	**0.91615**
0.96	**0.918424243**	**0.91532**
0.97	**0.917610499**	**0.91449**
0.98	**0.916797475**	**0.91366**
1	**0.915173589**	**0.912**
1.2	**0.899092084**	**0.8954**
1.25	**0.895116057**	**0.89125**
1.3	**0.891157613**	**0.8871**
1.35	**0.887216675**	**0.88295**
1.4	**0.883293164**	**0.8788**
1.5	**0.875498119**	**0.8705**

Table 11: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Depth [m]	Predictive Dissolve Sulphur on Heterogeneous silty Clay	Experimental Dissolve Sulphur on Heterogeneous silty Clay
0.2	0.980778425	0.9752
0.22	0.978876707	0.97352
0.24	0.976978676	0.97184
0.26	0.975084325	0.97016
0.28	0.973193647	0.96848
3	0.747418006	0.74
0.32	0.969423283	0.96512
0.34	0.967543582	0.96344
0.36	0.965667526	0.96176
0.38	0.963795107	0.96008
0.4	0.961926319	0.9584
0.42	0.960061155	0.95672
0.44	0.958199607	0.95504
0.46	0.956341668	0.95336
0.48	0.954487333	0.95168
0.5	0.952636592	0.95
0.52	0.95078944	0.94832
0.54	0.94894587	0.94664
0.56	0.947105875	0.94496
0.58	0.945269447	0.94328
0.6	0.94343658	0.9416
0.62	0.941607267	0.93992
0.64	0.939781501	0.93824
0.66	0.937959275	0.93656
0.68	0.936140583	0.93488
0.7	0.934325417	0.9332
0.72	0.93251377	0.93152
0.74	0.930705636	0.92984
0.76	0.928901008	0.92816
0.78	0.92709988	0.92648
0.82	0.923508092	0.92312
0.84	0.921717421	0.92144
0.86	0.919930221	0.91976
0.88	0.918146486	0.91808
0.9	0.91636621	0.9164
0.92	0.914589387	0.91472
0.94	0.912816008	0.91304
0.96	0.911046068	0.91136

0.98	0.90927956	0.90968
1	0.907516477	0.908
1.12	0.897009538	0.89792
1.14	0.895270247	0.89624
1.16	0.893534328	0.89456
1.18	0.891801775	0.89288
1.2	0.890072581	0.8912
1.22	0.88834674	0.88952
1.24	0.886624246	0.88784
1.26	0.884905091	0.88616
1.28	0.88318927	0.88448
2	0.823586156	0.824
2.22	0.806189304	0.80552
2.24	0.804626112	0.80384
2.26	0.80306595	0.80216
2.28	0.801508815	0.80048
3	0.747418006	0.74

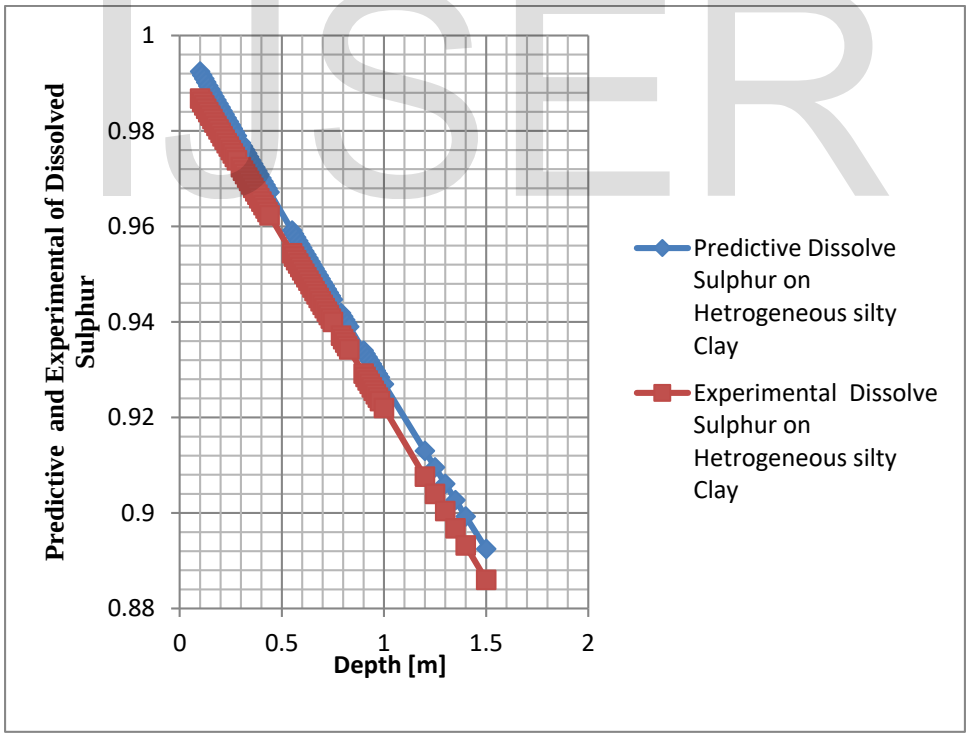

Figure 1: Predictive and Experimental Values for Sulphur Concentration at Different Depths

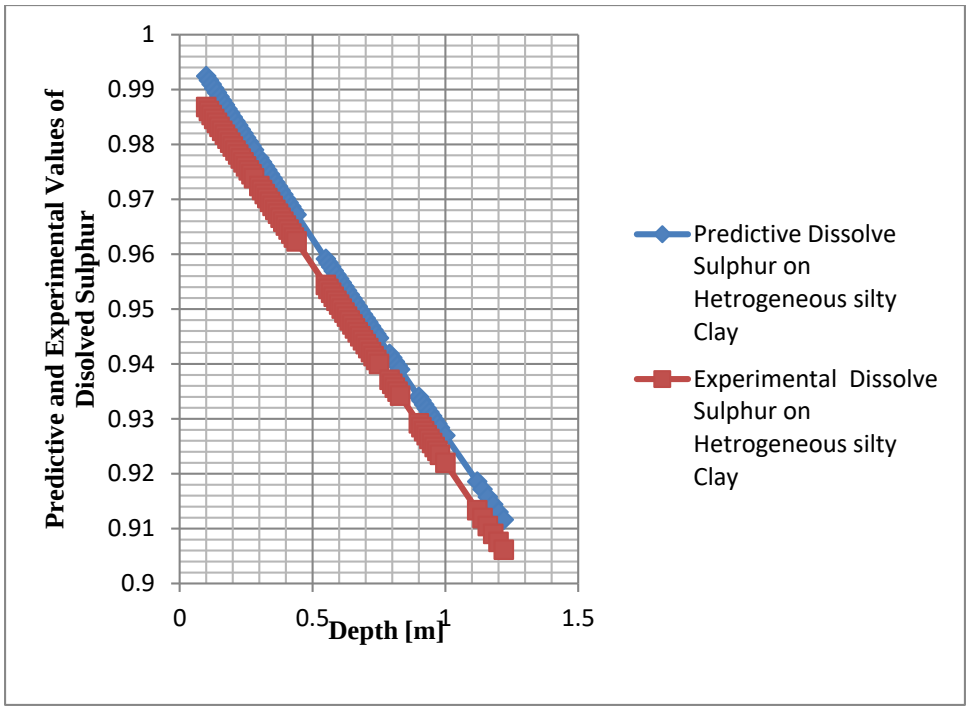

Figure 2: Predictive and Experimental Values for Sulphur Concentration at Different Depths

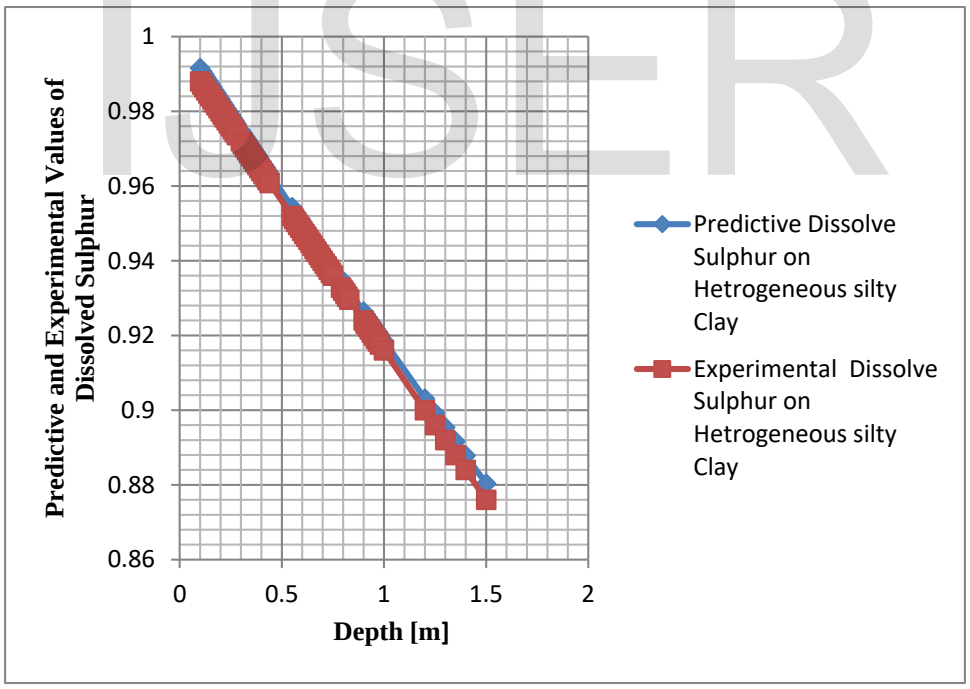

Figure 3: Predictive and Experimental Values for Sulphur Concentration at Different Depths

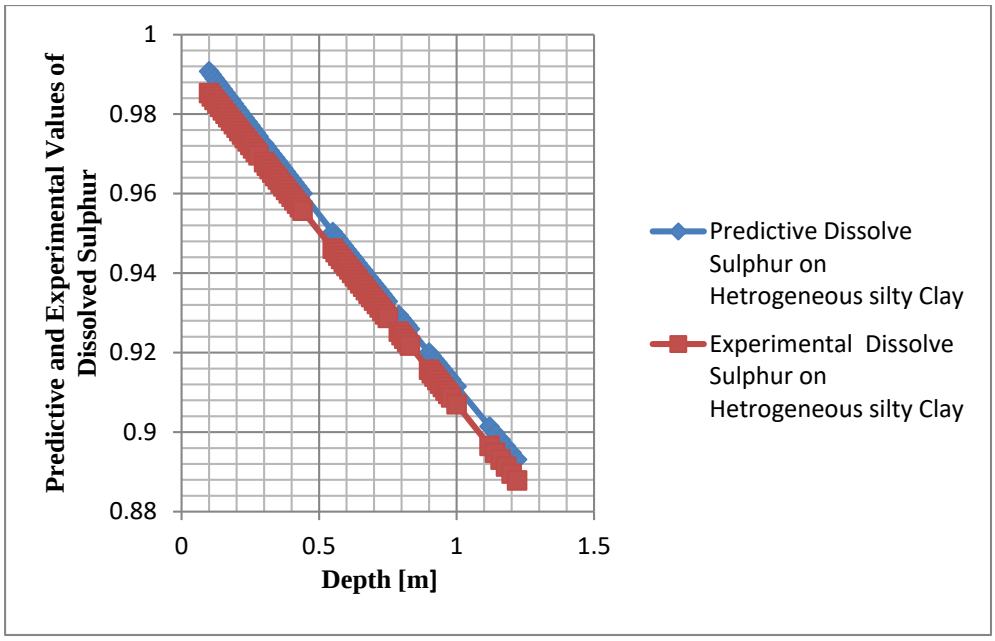

Figure 4: Predictive and Experimental Values for Sulphur Concentration at Different Depths

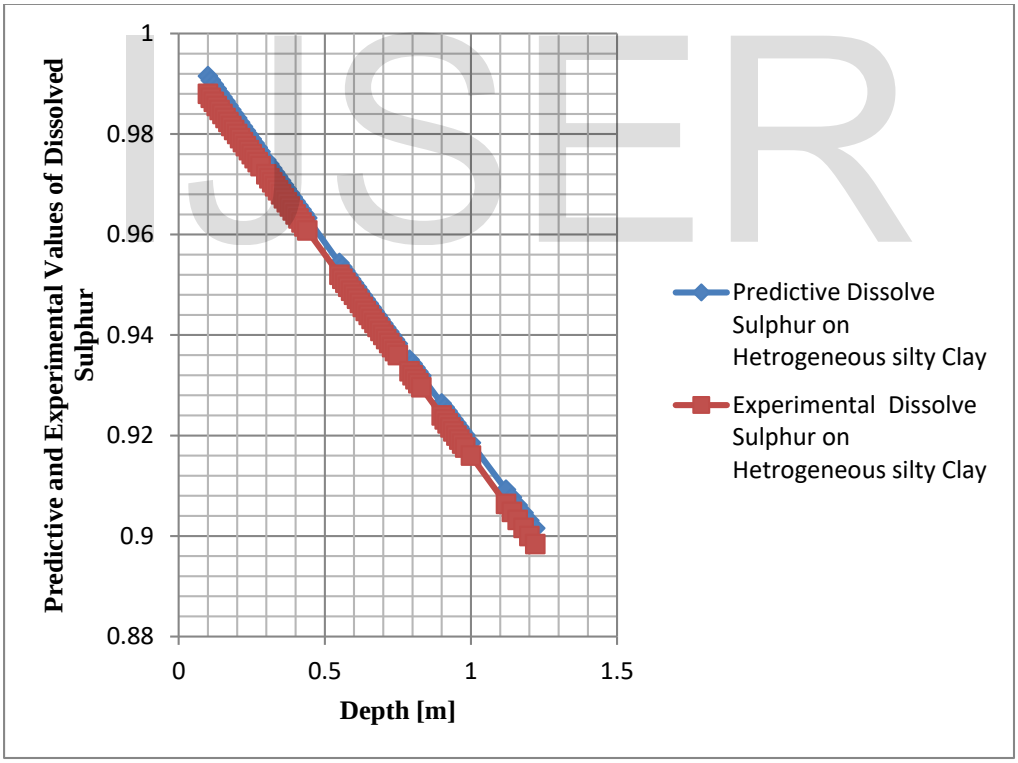

Figure 5: Predictive and Experimental Values for Sulphur Concentration at Different Depths

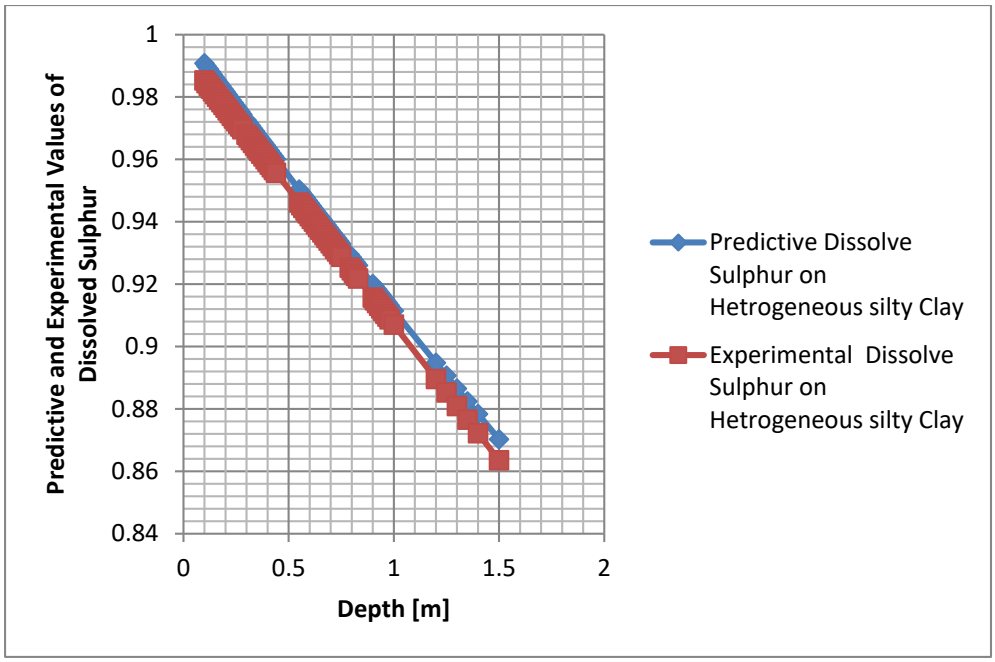

Figure 6: Predictive and Experimental Values for Sulphur Concentration at Different Depths

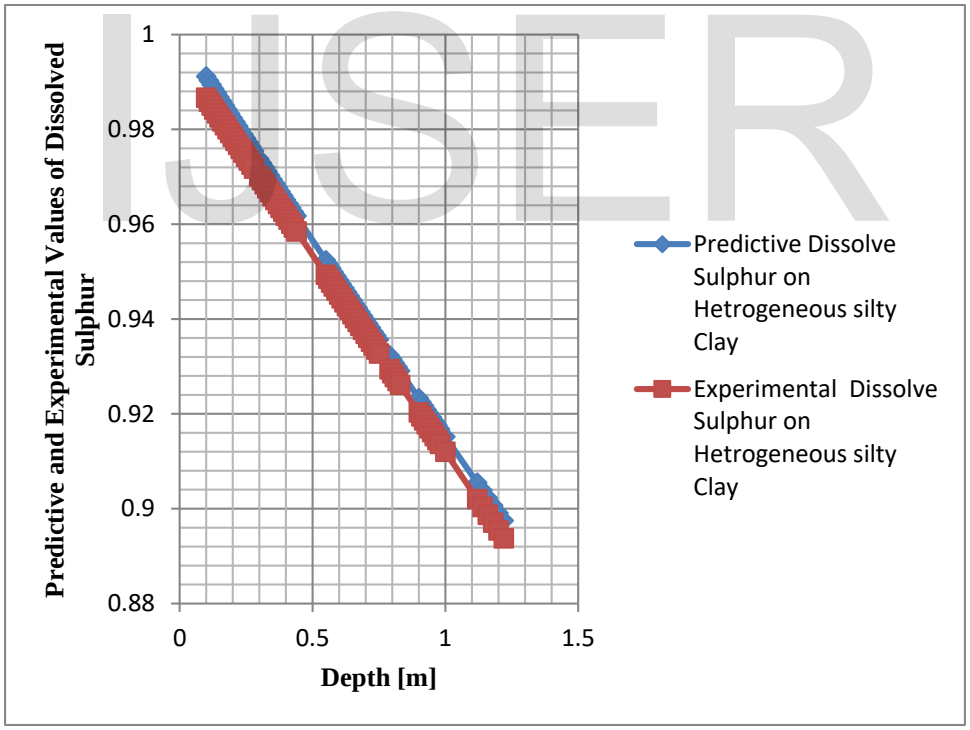

Figure 7: Predictive and Experimental Values for Sulphur Concentration at Different Depths

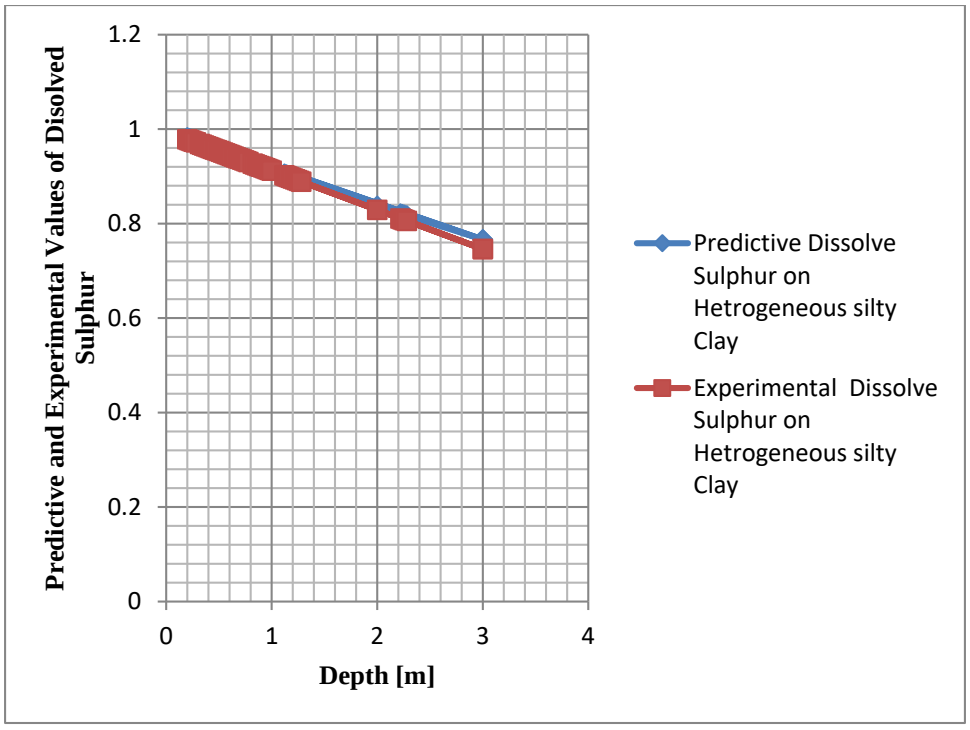

Figure 8: Predictive and Experimental Values for Sulphur Concentration at Different Depths

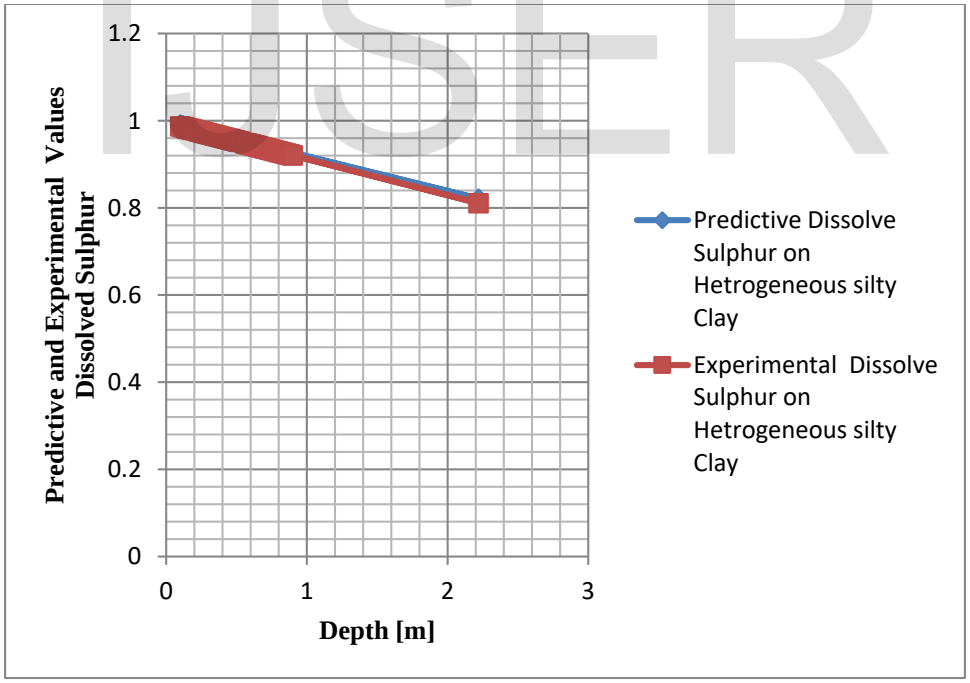

Figure 9: Predictive and Experimental Values for Sulphur Concentration at Different Depths

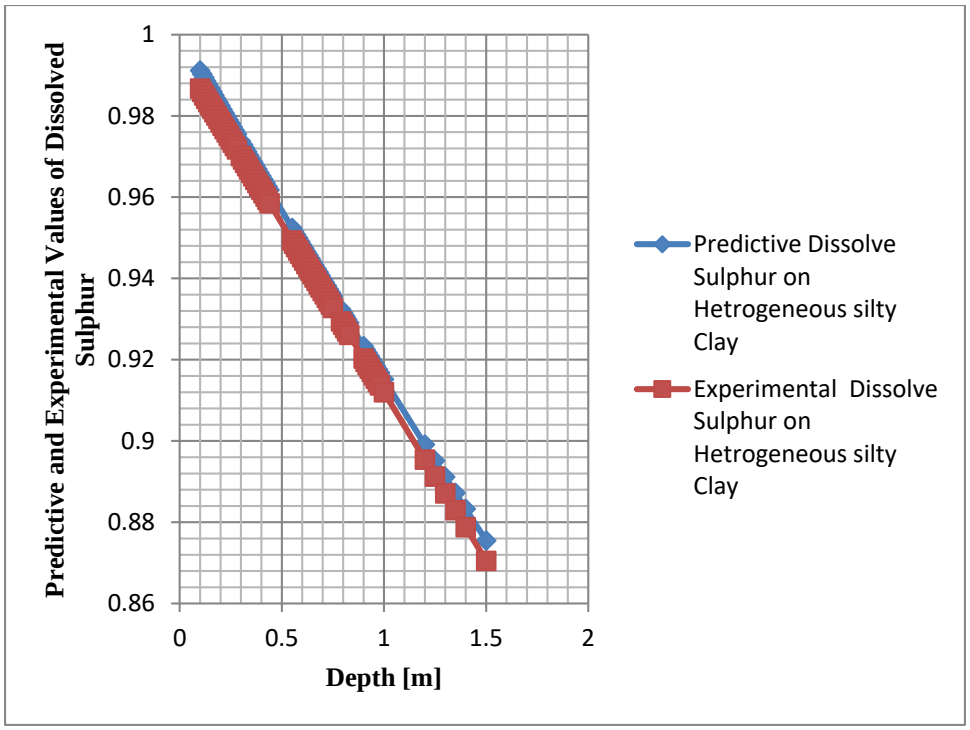

Figure 10: Predictive and Experimental Values for Sulphur Concentration at Different Depths

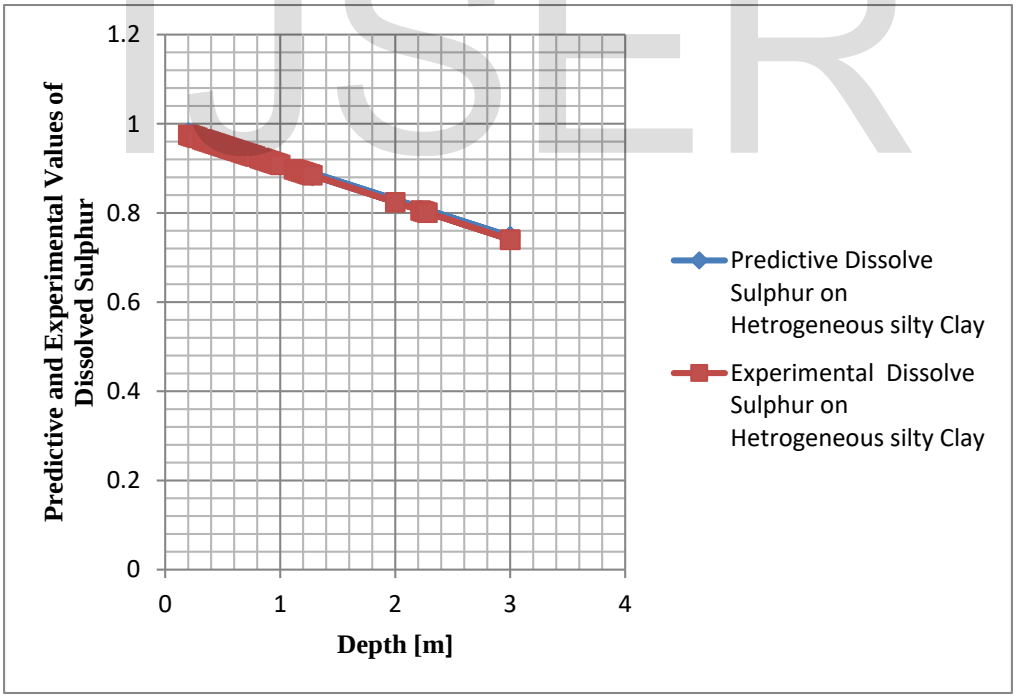

Figure 11: Predictive and Experimental Values for Sulphur Concentration at Different Depths

Figure one to eleven explained the linear decrease of Sulphur in terms of their deposition in heterogeneous silty clay, these were based on monitored parameters that were considered in the

study environment under its rates of influence in the transport and deposition of sulphur in silty clay, the transport of these substance in such deposition were monitored in two dimensional conditions in terms science and engineering approach, the litho structure of the formation scientifically from geological perspective, they are deposited in deltaic environment were heterogeneity was observed to be predominant in study area, these condition observed in the geological formation pressured the transport mechanism as it was experience in all the figures, such observation in these figures detailed the migration of sulphur in silty clay, the concentration experienced linear decrease in concentration from 0.1 -3metres deep, the deposition of sulphur in these figures monitored experienced variations at different concentrations in different figures even though they were all decreasing with respect to increase in depth, the study further observed their reactions as sulphur are deposited in soil that definitely contributes to acidification. The study also observed the adverse effect of sulphur contamination that are shown by the fall in P^h, these developed an increase of phytotoxic aluminium contamination, whereby through this condition, there will be loss of Ca2+ and Mg2+ ions through leaching. These process experienced changes that will definitely lead to soil degradation. The level of impact never ceased once the contaminant input that may carry over influence. It was found that these conditions, will definitely carry influence of sulphur pollution in soil that has developed greater influence than that of immediate impact. Furthermore, the process of this pollution source expressed a disturbance in relationships between Ca2+ and Al3+ ions that is brought about by long term sulphur depositions. These conditions were experienced in the reduction of crop yield especially in some sensitive plants. These negative impacts are reflected on the depositions of sulphur contamination through these stated sources in the studied area and are based on the rate of deposition through the porous media as is explained in content at different figures. Based on these factors even at declined rates the substance experienced a decrease in its rates but remains hazardous to human from agriculture and other activities.

5. Conclusion

The study explained the behaviour of sulphur migration rates even in its dissolved state. The transport of these substance was monitored at different dimensions, based on some variable that were considered to be influential parameters in the system that affect the migration and deposition of sulphur in soil. These conditions explained their behaviour at different locations in the study The process of simulation was used to observe the impact rate and it showed predominant decrease

with an increase in depth when in dissolved state and the figures are graphically represented. The transportation and deposition level as represented in these figures expressed their variation based their behaviour. The transportation condition was observed within a shallow depth of 1.5 - 3.0m far from the Phreatic zone. The sulphur content developed an increase in phytotoxic aluminium contamination and a loss of Ca2+ and Mg2+ ions through leaching. The changes experienced will definitely lead to soil degradation. A detailed source of sulphur deposition and its variations at different concentration with the depth was used to derive a model and generate values for its simulation, which was carried out considering the parameters at various rate of impact on the transport level and deposition of sulphur in different soils.

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