MODELING AND SIMULATION OF DISPERSION AND VELOCITY INFLUENCE ON SERRATIA MIGRATION IN STREAMS

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Abstract

The study of Serratia transport was monitored applying mathematical modelling techniques, in other to develop a model that monitored the contaminant. A thorough investigation was carried out and a physiochemical and microbial analysis was done to determine the rates of depositions. The level of microbial deposition was monitored and influential variables where observed. Some of the parameters used were stream velocity, diffusion and dispersion, the study experienced heterogeneity in their effect, which allowed for variations of concentration in all the figures. The behaviour of the microbes was observed from graphical presentation in all the figures, which implied that the transport systems were influenced. It was also observed that there was a gradual and rapid decrease with respect to increase in concentration. The derived model for Serratia transport was applied to investigate the process where a decrease with respect to increase in distanced was also observed.The derived model was validated with experimental data and all parameters developed were positively correlated. This study is imperative because it served to illustrate the cause of decrease in concentration through dispersion which reflected the spread of the contaminant on stream velocity.The transport of Serratia under the influence of these three parameters that was evaluated with experimental values.

Keywords: Modelling Dispersions, Serrati, Migration and Stream

1. Introduction

Numerous studies have detailed the threat of pathogen contaminations in lakes and reservoirs.Lakes and reservoirs have been observed to serve asthe main source of drinking water in some Countries.These surface water bodiesare known frequently to bevulnerable to pathogen contamination (Kistemann et al., 2002). But in developed Nations, it has been observed that, anincreaseof awareness on water quality and water treatment for pathogen contamination has reduced theoutbreak of water-borne diseases via public water supplies (Gibson et al., 1998; Howe et al., 2002; Brookes et al., 2004). As illustrated by (MacKenzie et al., 1994; Cicirello et al., 1997),

throughout the spring of 1993 an estimated 403,000 residents of greater Milwaukee, Wisconsin area, experienced gastrointestinal illness due to infection with the parasite Cryptosporidium parvum.These findings were based on followingthe contamination of the city's water supply and the issue was associated with inadequate filtration of contaminated water from Lake Michigan.In the 1990s, Cryptosporidiosismicrobes was known to be the most familiar cause of outbreaks of illness and was associated with public drinking water supplies in the United Kingdom (Howe et al., 2002). But in developing nations, it has been rather difficult to approximate the exact morbidity as surveillance systems are rudimentaryand several cases may not have been reported.Moreover, in these developing Countries, diseases such as DiarrhoeaandCholera are known to be the leading cause of morbidity (Nelson et al., 2009). Furthermore, Diarrhoeaassociated with drinking water is predicted to be responsible for 2 to 2.5 million deaths annually (Fenwick, 2006).In lakes and reservoirs, increasesin pathogens areoften associated with storm events, but stream inflow is considered to be the major source of pathogens. During rainy seasons, the influx of polluted water from streams to lakes including reservoirs can increase pathogen levels substantially (Kistemann et al., 2002,Harvell et al 1999,Harvell et al 2002). The amount of pathogen influxes from lakes and reservoirs tributaries during rainy seasons is of particular significance in determining pathogen transport and distribution (Brookes et al., 2004; Fayer and Trout, 2005; Gerba, 2005; Hipsey et al., 2008).

2. Theoretical Background

$$\frac{dc}{dx} + \beta(x)K = A(x) \quad \text{............} \quad 1$$

Multiplying the equation through by $C[x]$, we have:

$$C(x)\frac{dC}{dx} + C(x)\beta(x)K = C(x)A(x) \quad \text{............} \quad 2$$

Let $P(x) = C(x)\beta(x)$ 3

Then Equation (2), we have:

$$C(x)\frac{dC}{dx} + C(x)\beta(x)K = C(x)A(x) \quad \text{............} \quad 4$$

$$C(x)\frac{dC}{dx}+P(x)K=C(x)A(x) \quad \text{……} \quad 5$$

$$\boxed{C(x)P^1+P(x)K=C(x)A(x)} \quad \text{……} \quad 6$$

$$C(x)P^1=C(x)A-P(x)K \quad \text{……} \quad 7$$

Differentiate 2nd term on the left-hand sideof (6) with respect to x, we have

$$K\frac{dC}{dx}=C(x)A(x)-C(x)P^1 \quad \text{……} \quad 8$$

$$\frac{dC}{dx}=\frac{1}{K}\left[C(x)A(x)-C(x)P^1\right] \quad \text{……} \quad 9$$

$$\frac{dC}{dx}=\frac{C(x)}{K}\left[A(x)-P^1\right] \quad \text{……} \quad 10$$

Applying separation of variables, by dividing through by C(x) and cross multiply by dx, gives:

$$\frac{dC}{C}=\frac{1}{K}\left[A(x)-P^1\right]dx \quad \text{……} \quad 11$$

$$\frac{1}{C(x)}dC=\frac{1}{K}\left[A(x)-P^1\right]dx \quad \text{…..……} \quad 12$$

$$\frac{1}{C(x)}dC=\left(\frac{A(x)}{K}-\frac{P^1}{K}\right)dx \quad \text{……} \quad 13$$

$$\int\frac{1}{C(x)}dC=\int\left(\frac{A(x)}{K}-\frac{P^1}{K}\right)dx+\eta \quad \text{……} \quad 14$$

$$\ln C(x)=\int A(x)dx-\int\frac{P^1}{K}dx+\eta \quad \text{……`} \quad 15$$

$$\ln C(x)=\frac{1}{K}\left[Ax-P^1\right]x+\eta \quad \text{…… `} \quad 16$$

$$\ln C(x)=\left(\frac{A(x)}{K}-\frac{P^1}{K}\right)x+\eta \quad \text{……..} \quad 17$$

Taking exponent of the both side of the equation

$$C(x) = \ell^{\left(\frac{A(x)}{K} - \frac{P^1}{K} + \eta\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 18$$

$$C(x) = D\ell^{\frac{1}{K}\left(Ax - P^1 x\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \mathbf{20}$$

3. Material and Method

Standard laboratory experiments were carried out to monitor Serratia using the standard method of sampling at different stations. The water samples were collected in sequences based on specification as stipulated at different locations.These samples collected generated variations at different distances, producing different Serratia concentrations through physiochemical analysis andthe experimental results were compared with the theoretical values for model validation.

4. Results and Discussion

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

Table 1: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.5/0.22]	Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion coefficient [1.5/0.22]
2	0.002387302	0.0023477
4	0.002340471	0.002308883
6	0.002294559	0.002270837
8	0.002249548	0.002233548
10	0.002205419	0.002197002
12	0.002162157	0.002161184
14	0.002119743	0.002126079
16	0.00207816	0.002091673
18	0.002037394	0.002057952
20	0.001997427	0.002024902
22	0.001958245	0.001992508

24	**0.00191983**	**0.001960755**
26	**0.00188217**	**0.001929629**
28	**0.001845248**	**0.001899116**
30	**0.001809051**	**0.001869202**
32	**0.001773563**	**0.001839872**
34	**0.001738772**	**0.001811111**
38	**0.001671224**	**0.00175524**
40	**0.00163844**	**0.001728102**
42	**0.001606299**	**0.001701476**
44	**0.001574789**	**0.001675347**
46	**0.001543897**	**0.001649701**
48	**0.001513611**	**0.001624524**
50	**0.001483919**	**0.001599802**
54	**0.001426271**	**0.001551663**
56	**0.001398293**	**0.001528217**
58	**0.001370863**	**0.001505168**
60	**0.001343971**	**0.001482502**
62	**0.001317607**	**0.001460204**
64	**0.00129176**	**0.001438259**
66	**0.00126642**	**0.001416653**
68	**0.001241577**	**0.001395372**
70	**0.001217222**	**0.001374402**
72	**0.001193344**	**0.001353728**
74	**0.001169935**	**0.001333335**
76	**0.001146985**	**0.001313209**
78	**0.001124485**	**0.001293336**
80	**0.001102426**	**0.001273702**
82	**0.0010808**	**0.001254292**
84	**0.001059599**	**0.001235091**
86	**0.001038813**	**0.001216085**
88	**0.001018435**	**0.00119726**
90	**0.000998457**	**0.001178602**

Table 2: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	**Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.5/0.023]**	**Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.5/0.23]**

2	**0.002387302**	**0.0023477**
4	**0.002340471**	**0.002308883**
6	**0.002294559**	**0.002270837**
8	**0.002249548**	**0.002233548**
10	**0.002205419**	**0.002197002**
12	**0.002162157**	**0.002161184**
14	**0.002119743**	**0.002126079**
16	**0.00207816**	**0.002091673**
18	**0.002037394**	**0.002057952**
20	**0.001997427**	**0.002024902**
22	**0.001958245**	**0.001992508**
24	**0.00191983**	**0.001960755**
26	**0.00188217**	**0.001929629**
28	**0.001845248**	**0.001899116**
30	**0.001809051**	**0.001869202**
32	**0.001773563**	**0.001839872**
34	**0.001738772**	**0.001811111**
38	**0.001671224**	**0.00175524**
40	**0.00163844**	**0.001728102**
42	**0.001606299**	**0.001701476**
44	**0.001574789**	**0.001675347**
46	**0.001543897**	**0.001649701**
48	**0.001513611**	**0.001624524**
50	**0.001483919**	**0.001599802**
54	**0.001426271**	**0.001551663**
56	**0.001398293**	**0.001528217**
58	**0.001370863**	**0.001505168**
60	**0.001343971**	**0.001482502**
62	**0.001317607**	**0.001460204**
64	**0.00129176**	**0.001438259**
66	**0.00126642**	**0.001416653**
68	**0.001241577**	**0.001395372**
70	**0.001217222**	**0.001374402**
72	**0.001193344**	**0.001353728**
74	**0.001169935**	**0.001333335**
76	**0.001146985**	**0.001313209**
78	**0.001124485**	**0.001293336**
80	**0.001102426**	**0.001273702**
82	**0.0010808**	**0.001254292**

84	**0.001059599**	**0.001235091**
86	**0.001038813**	**0.001216085**
88	**0.001018435**	**0.00119726**
90	**0.000998457**	**0.001178602**

Table 3: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.52/0.024]	Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.52/0.24]
2	**0.002604334**	**0.002544732**
4	**0.00255325**	**0.002485915**
6	**0.002503168**	**0.002427869**
8	**0.002454068**	**0.00237058**
10	**0.002405931**	**0.002314034**
12	**0.002358739**	**0.002258216**
14	**0.002312472**	**0.002203111**
16	**0.002267113**	**0.002148705**
18	**0.002222644**	**0.002094984**
20	**0.002179047**	**0.002041934**
22	**0.002136304**	**0.00198954**
24	**0.002094401**	**0.001937787**
26	**0.002053319**	**0.001886661**
28	**0.002013043**	**0.001836148**
30	**0.001973557**	**0.001786234**
32	**0.001934846**	**0.001736904**
34	**0.001896894**	**0.001688143**
38	**0.001823209**	**0.001592272**
40	**0.001787446**	**0.001545134**
42	**0.001752385**	**0.001498508**
44	**0.001718012**	**0.001452379**
46	**0.001684314**	**0.001406733**
48	**0.001651276**	**0.001361556**
50	**0.001618886**	**0.001316834**
54	**0.001556**	**0.001228695**
56	**0.001525479**	**0.001185249**
58	**0.001495557**	**0.0011422**

60	**0.001466221**	**0.001099534**
62	**0.001437461**	**0.001057236**
64	**0.001409265**	**0.001015291**
66	**0.001381623**	**0.000973685**
68	**0.001354522**	**0.000932404**
70	**0.001327953**	**0.000891434**
72	**0.001301905**	**0.00085076**
74	**0.001276368**	**0.000810367**
76	**0.001251332**	**0.000770241**
78	**0.001226787**	**0.000730368**
80	**0.001202724**	**0.000690734**
82	**0.001179133**	**0.000651324**
84	**0.001156004**	**0.000612123**
86	**0.001133329**	**0.000573117**
88	**0.001111099**	**0.000534292**
90	**0.001089304**	**0.000495634**

Table 4: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	**Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.53/0.0256]**	**Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.53/0.256]**
2	**0.002768641**	**0.002698224**
4	**0.002705233**	**0.002639424**
6	**0.002643277**	**0.002581424**
8	**0.00258274**	**0.002524224**
10	**0.002523589**	**0.002467824**
12	**0.002465793**	**0.002412224**
14	**0.002409321**	**0.002357424**
16	**0.002354141**	**0.002303424**
18	**0.002300226**	**0.002250224**
20	**0.002247546**	**0.002197824**
22	**0.002196072**	**0.002146224**
24	**0.002145776**	**0.002095424**
26	**0.002096633**	**0.002045424**
28	**0.002048615**	**0.001996224**
30	**0.002001697**	**0.001947824**

32	**0.001955854**	**0.001900224**
34	**0.00191106**	**0.001853424**
38	**0.001824527**	**0.001762224**
40	**0.001782741**	**0.001717824**
42	**0.001741912**	**0.001674224**
44	**0.001702018**	**0.001631424**
46	**0.001663038**	**0.001589424**
48	**0.001624951**	**0.001548224**
50	**0.001587736**	**0.001507824**
54	**0.001515843**	**0.001429424**
56	**0.001481126**	**0.001391424**
58	**0.001447205**	**0.001354224**
60	**0.001414061**	**0.001317824**
62	**0.001381675**	**0.001282224**
64	**0.001350032**	**0.001247424**
66	**0.001319113**	**0.001213424**
68	**0.001288902**	**0.001180224**
70	**0.001259383**	**0.001147824**
72	**0.001230541**	**0.001116224**
74	**0.001202358**	**0.001085424**
76	**0.001174821**	**0.001055424**
78	**0.001147915**	**0.001026224**
80	**0.001121625**	**0.000997824**
82	**0.001095938**	**0.000970224**
84	**0.001070838**	**0.000943424**
86	**0.001046313**	**0.000917424**
88	**0.00102235**	**0.000892224**
90	**0.000998936**	**0.000867824**

Table 5: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	**Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.56/0.027]**	**Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.56/0.27]**
2	**0.002933438**	**0.00294036**
4	**0.002879395**	**0.00288144**
6	**0.002826348**	**0.00282324**

8	**0.002774278**	**0.00276576**
10	**0.002723168**	**0.002709**
12	**0.002672999**	**0.00265296**
14	**0.002623754**	**0.00259764**
16	**0.002575417**	**0.00254304**
18	**0.00252797**	**0.00248916**
20	**0.002481397**	**0.002436**
22	**0.002435682**	**0.00238356**
24	**0.00239081**	**0.00233184**
26	**0.002346764**	**0.00228084**
28	**0.002303529**	**0.00223056**
30	**0.002261092**	**0.002181**
32	**0.002219435**	**0.00213216**
34	**0.002178547**	**0.00208404**
38	**0.002099016**	**0.00198996**
40	**0.002060345**	**0.001944**
42	**0.002022388**	**0.00189876**
44	**0.001985129**	**0.00185424**
46	**0.001948557**	**0.00181044**
48	**0.001912659**	**0.00176736**
50	**0.001877422**	**0.001725**
54	**0.001808884**	**0.00164244**
56	**0.001775559**	**0.00160224**
58	**0.001742848**	**0.00156276**
60	**0.001710739**	**0.001524**
62	**0.001679222**	**0.00148596**
64	**0.001648286**	**0.00144864**
66	**0.001617919**	**0.00141204**
68	**0.001588113**	**0.00137616**
70	**0.001558855**	**0.001341**
72	**0.001530136**	**0.00130656**
74	**0.001501946**	**0.00127284**
76	**0.001474276**	**0.00123984**
78	**0.001447115**	**0.00120756**
80	**0.001420455**	**0.001176**
82	**0.001394286**	**0.00114516**
84	**0.001368599**	**0.00111504**
86	**0.001343385**	**0.00108564**
88	**0.001318636**	**0.00105696**

90	**0.001294343**	**0.001029**

Table 6: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.57/0.0275]	Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.57/0.275]
2	**0.002987764**	**0.002928124**
4	**0.002932723**	**0.002869204**
6	**0.002878696**	**0.002811004**
8	**0.002825664**	**0.002753524**
10	**0.00277361**	**0.002696764**
12	**0.002722514**	**0.002640724**
14	**0.00267236**	**0.002585404**
16	**0.002623129**	**0.002530804**
18	**0.002574806**	**0.002476924**
20	**0.002527373**	**0.002423764**
22	**0.002480813**	**0.002371324**
24	**0.002435111**	**0.002319604**
26	**0.002390252**	**0.002268604**
28	**0.002346218**	**0.002218324**
30	**0.002302996**	**0.002168764**
32	**0.00226057**	**0.002119924**
34	**0.002218926**	**0.002071804**
38	**0.002137924**	**0.001977724**
40	**0.002098539**	**0.001931764**
42	**0.00205988**	**0.001886524**
44	**0.002021933**	**0.001842004**
46	**0.001984684**	**0.001798204**
48	**0.001948122**	**0.001755124**
50	**0.001912234**	**0.001712764**
54	**0.001842428**	**0.001630204**
56	**0.001808487**	**0.001590004**
58	**0.001775171**	**0.001550524**

60	**0.001742468**	**0.001511764**
62	**0.001710369**	**0.001473724**
64	**0.00167886**	**0.001436404**
66	**0.001647932**	**0.001399804**
68	**0.001617574**	**0.001363924**
70	**0.001587775**	**0.001328764**
72	**0.001558524**	**0.001294324**
74	**0.001529813**	**0.001260604**
76	**0.001501631**	**0.001227604**
78	**0.001473968**	**0.001195324**
80	**0.001446814**	**0.001163764**
82	**0.001420161**	**0.001132924**
84	**0.001393999**	**0.001102804**
86	**0.001368318**	**0.001073404**
88	**0.001343111**	**0.001044724**
90	**0.001318368**	**0.001016764**

Table 7: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	**Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.59/0.028]**	**Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.59/0.28]**
2	**0.003039313**	**0.00297949**
4	**0.002980602**	**0.00292057**
6	**0.002923025**	**0.00286237**
8	**0.00286656**	**0.00280489**
10	**0.002811186**	**0.00274813**
12	**0.002756882**	**0.00269209**
14	**0.002703627**	**0.00263677**
16	**0.0026514**	**0.00258217**
18	**0.002600183**	**0.00252829**
20	**0.002549954**	**0.00247513**
22	**0.002500697**	**0.00242269**
24	**0.00245239**	**0.00237097**
26	**0.002405017**	**0.00231997**
28	**0.002358559**	**0.00226969**
30	**0.002312998**	**0.00222013**
32	**0.002268317**	**0.00217129**

34	**0.0022245**	**0.00212317**
38	**0.002139388**	**0.00202909**
40	**0.002098061**	**0.00198313**
42	**0.002057532**	**0.00193789**
44	**0.002017786**	**0.00189337**
46	**0.001978808**	**0.00184957**
48	**0.001940583**	**0.00180649**
50	**0.001903097**	**0.00176413**
54	**0.001830282**	**0.00168157**
56	**0.001794926**	**0.00164137**
58	**0.001760253**	**0.00160189**
60	**0.00172625**	**0.00156313**
62	**0.001692904**	**0.00152509**
64	**0.001660201**	**0.00148777**
66	**0.001628131**	**0.00145117**
68	**0.00159668**	**0.00141529**
70	**0.001565837**	**0.00138013**
72	**0.001535589**	**0.00134569**
74	**0.001505926**	**0.00131197**
76	**0.001476836**	**0.00127897**
78	**0.001448307**	**0.00124669**
80	**0.00142033**	**0.00121513**
82	**0.001392893**	**0.00118429**
84	**0.001365987**	**0.00115417**
86	**0.0013396**	**0.00112477**
88	**0.001313722**	**0.00109609**
90	**0.001288345**	**0.00106813**

Table 8: Predictive and Experimental Values for Serratia Concentration at Different Distance

Distance [x]	**Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.61/0.030]**	**Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.61/0.30]**
2	**0.003263587**	**0.003203907**
4	**0.003207602**	**0.003144867**
6	**0.003152577**	**0.003086467**
8	**0.003098496**	**0.003028707**

10	**0.003045343**	**0.002971587**
12	**0.002993101**	**0.002915107**
14	**0.002941756**	**0.002859267**
16	**0.002891291**	**0.002804067**
18	**0.002841692**	**0.002749507**
20	**0.002792944**	**0.002695587**
22	**0.002745033**	**0.002642307**
24	**0.002697943**	**0.002589667**
26	**0.002651661**	**0.002537667**
28	**0.002606173**	**0.002486307**
30	**0.002561465**	**0.002435587**
32	**0.002517524**	**0.002385507**
34	**0.002474337**	**0.002336067**
38	**0.002390173**	**0.002239107**
40	**0.00234917**	**0.002191587**
42	**0.002308871**	**0.002144707**
44	**0.002269264**	**0.002098467**
46	**0.002230336**	**0.002052867**
48	**0.002192075**	**0.002007907**
50	**0.002154471**	**0.001963587**
54	**0.002081187**	**0.001876867**
56	**0.002045485**	**0.001834467**
58	**0.002010396**	**0.001792707**
60	**0.001975908**	**0.001751587**
62	**0.001942012**	**0.001711107**
64	**0.001908698**	**0.001671267**
66	**0.001875955**	**0.001632067**
68	**0.001843774**	**0.001593507**
70	**0.001812145**	**0.001555587**
72	**0.001781058**	**0.001518307**
74	**0.001750505**	**0.001481667**
76	**0.001720476**	**0.001445667**
78	**0.001690962**	**0.001410307**
80	**0.001661954**	**0.001375587**
82	**0.001633444**	**0.001341507**
84	**0.001605423**	**0.001308067**
86	**0.001577883**	**0.001275267**
88	**0.001550815**	**0.001243107**
90	**0.001524211**	**0.001211587**

Table 9: Predictive and Experimental Values for Serratia Concentration at Different Distance

Depth [m]	Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.59/0.028]	Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.59/0.28]
0.1	0.003096159	0.00309316
0.11	0.003095857	0.00309286
0.12	0.003095555	0.00309256
0.13	0.003095253	0.003092261
0.14	0.003094951	0.003091961
0.15	0.003094649	0.003091661
0.16	0.003094348	0.003091361
0.17	0.003094046	0.003091062
0.18	0.003093744	0.003090762
0.19	0.003093442	0.003090462
0.2	0.003093141	0.003090163
0.21	0.003092839	0.003089863
0.22	0.003092537	0.003089563
0.23	0.003092236	0.003089264
0.24	0.003091934	0.003088964
0.25	0.003091633	0.003088665
0.26	0.003091331	0.003088365
0.27	0.00309103	0.003088066
0.28	0.003090728	0.003087766
0.3	0.003090125	0.003087167
0.31	0.003089824	0.003086868
0.32	0.003089523	0.003086568
0.33	0.003089221	0.003086269
0.34	0.00308892	0.003085969
0.35	0.003088619	0.00308567
0.36	0.003088317	0.003085371
0.37	0.003088016	0.003085071
0.38	0.003087715	0.003084772

0.39	**0.003087414**	**0.003084473**
0.4	**0.003087113**	**0.003084173**
0.41	**0.003086812**	**0.003083874**
0.42	**0.003086511**	**0.003083575**
0.43	**0.00308621**	**0.003083276**
0.44	**0.003085909**	**0.003082976**
0.55	**0.0030826**	**0.003079686**
0.56	**0.003082299**	**0.003079387**
0.57	**0.003081999**	**0.003079088**
0.58	**0.003081698**	**0.003078789**
0.59	**0.003081398**	**0.00307849**
0.6	**0.003081097**	**0.003078191**
0.61	**0.003080797**	**0.003077892**
0.62	**0.003080496**	**0.003077594**
0.63	**0.003080196**	**0.003077295**
0.64	**0.003079895**	**0.003076996**
0.65	**0.003079595**	**0.003076697**
0.66	**0.003079295**	**0.003076398**
0.67	**0.003078994**	**0.003076099**
0.68	**0.003078694**	**0.003075801**
0.69	**0.003078394**	**0.003075502**
0.7	**0.003078093**	**0.003075203**
0.71	**0.003077793**	**0.003074904**
0.72	**0.003077493**	**0.003074606**
0.73	**0.003077193**	**0.003074307**
0.74	**0.003076893**	**0.003074008**
0.75	**0.003076593**	**0.00307371**
0.79	**0.003075393**	**0.003072515**
0.8	**0.003075093**	**0.003072217**
0.81	**0.003074793**	**0.003071918**
0.82	**0.003074493**	**0.00307162**
0.83	**0.003074193**	**0.003071321**
0.9	**0.003072095**	**0.003069232**
0.91	**0.003071795**	**0.003068934**
0.92	**0.003071496**	**0.003068635**
0.93	**0.003071196**	**0.003068337**
0.94	**0.003070897**	**0.003068039**
0.95	**0.003070597**	**0.00306774**
0.96	**0.003070298**	**0.003067442**
0.97	**0.003069998**	**0.003067144**
0.98	**0.003069699**	**0.003066845**

1	0.0030691	0.003066249
1.2	0.003063119	0.003060289
1.25	0.003061626	0.0030588
1.3	0.003060133	0.003057311
1.35	0.003058642	0.003055823
1.4	0.00305715	0.003054335

Table 10: Predictive and Experimental Values for Serratia Concentration at Different Distance

Depth [m]	Predictive Values of Serratia Concentration. [Mg/L] Variation of VelocityDispersion Coefficient [1.59/0.028]	Experimental Values of Serratia Concentration. [Mg/L] Variation of Velocityand Dispersion Coefficient [1.59/0.28]
0.1	0.003096159	0.00309316
0.11	0.003095857	0.00309286
0.12	0.003095555	0.00309256
0.13	0.003095253	0.003092261
0.14	0.003094951	0.003091961
0.15	0.003094649	0.003091661
0.16	0.003094348	0.003091361
0.17	0.003094046	0.003091062
0.18	0.003093744	0.003090762
0.19	0.003093442	0.003090462
0.2	0.003093141	0.003090163
0.21	0.003092839	0.003089863
0.22	0.003092537	0.003089563
0.23	0.003092236	0.003089264
0.24	0.003091934	0.003088964
0.25	0.003091633	0.003088665
0.26	0.003091331	0.003088365
0.27	0.00309103	0.003088066
0.28	0.003090728	0.003087766
0.3	0.003090125	0.003087167
0.31	0.003089824	0.003086868
0.32	0.003089523	0.003086568
0.33	0.003089221	0.003086269
0.34	0.00308892	0.003085969
0.35	0.003088619	0.00308567

0.36	**0.003088317**	**0.003085371**
0.37	**0.003088016**	**0.003085071**
0.38	**0.003087715**	**0.003084772**
0.39	**0.003087414**	**0.003084473**
0.4	**0.003087113**	**0.003084173**
0.41	**0.003086812**	**0.003083874**
0.42	**0.003086511**	**0.003083575**
0.43	**0.00308621**	**0.003083276**
0.44	**0.003085909**	**0.003082976**
0.55	**0.0030826**	**0.003079686**
0.56	**0.003082299**	**0.003079387**
0.57	**0.003081999**	**0.003079088**
0.58	**0.003081698**	**0.003078789**
0.59	**0.003081398**	**0.00307849**
0.6	**0.003081097**	**0.003078191**
0.61	**0.003080797**	**0.003077892**
0.62	**0.003080496**	**0.003077594**
0.63	**0.003080196**	**0.003077295**
0.64	**0.003079895**	**0.003076996**
0.65	**0.003079595**	**0.003076697**
0.66	**0.003079295**	**0.003076398**
0.67	**0.003078994**	**0.003076099**
0.68	**0.003078694**	**0.003075801**
0.69	**0.003078394**	**0.003075502**
0.7	**0.003078093**	**0.003075203**
0.71	**0.003077793**	**0.003074904**
0.72	**0.003077493**	**0.003074606**
0.73	**0.003077193**	**0.003074307**
0.74	**0.003076893**	**0.003074008**
0.75	**0.003076593**	**0.00307371**
0.79	**0.003075393**	**0.003072515**
0.8	**0.003075093**	**0.003072217**
0.81	**0.003074793**	**0.003071918**
0.82	**0.003074493**	**0.00307162**
0.83	**0.003074193**	**0.003071321**
0.9	**0.003072095**	**0.003069232**
0.91	**0.003071795**	**0.003068934**
0.92	**0.003071496**	**0.003068635**
0.93	**0.003071196**	**0.003068337**
0.94	**0.003070897**	**0.003068039**

0.95	**0.003070597**	**0.00306774**
0.96	**0.003070298**	**0.003067442**
0.97	**0.003069998**	**0.003067144**
0.98	**0.003069699**	**0.003066845**
1	**0.0030691**	**0.003066249**
1.2	**0.003063119**	**0.003060289**
1.25	**0.003061626**	**0.0030588**
1.3	**0.003060133**	**0.003057311**
1.35	**0.003058642**	**0.003055823**
1.4	**0.00305715**	**0.003054335**

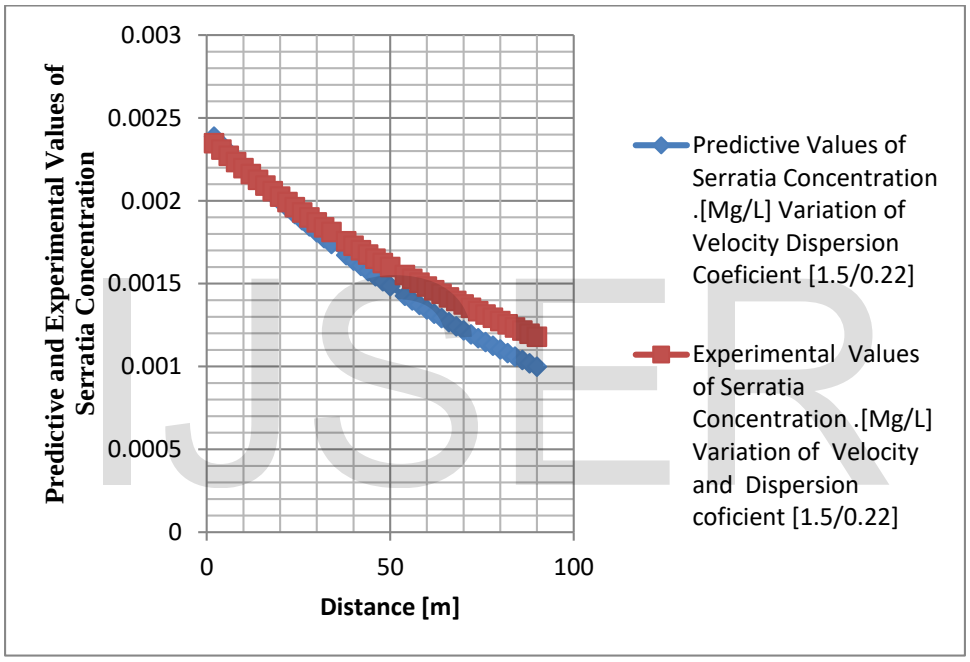

Figure 1: Predictive and Experimental Values for Serratia Concentration at Different Distance

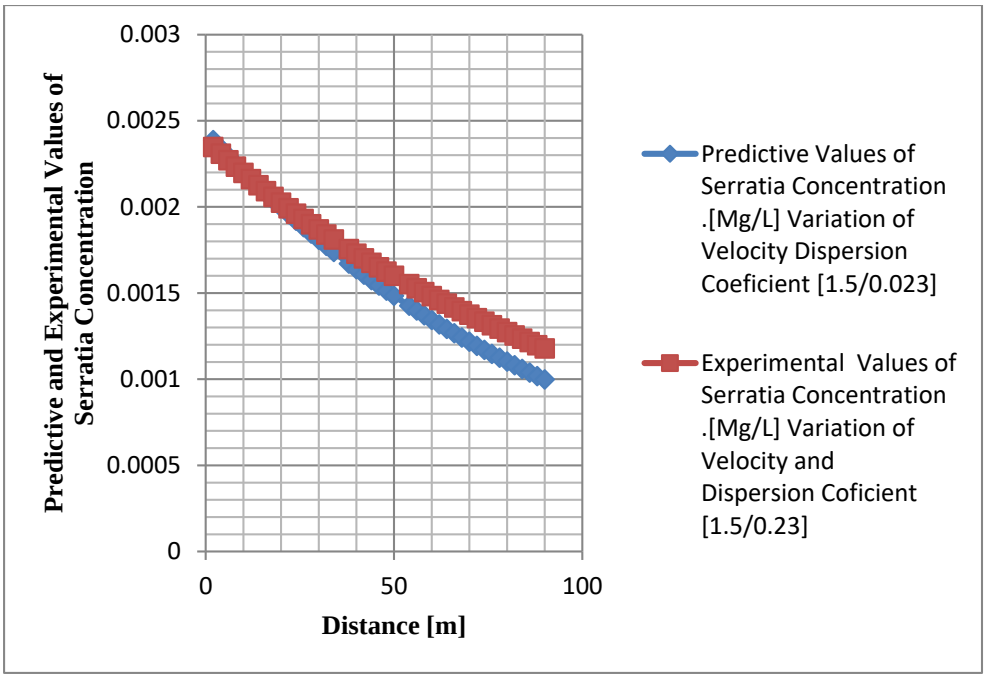

Figure 2: Predictive and Experimental Values for Serratia Concentration at Different Distance

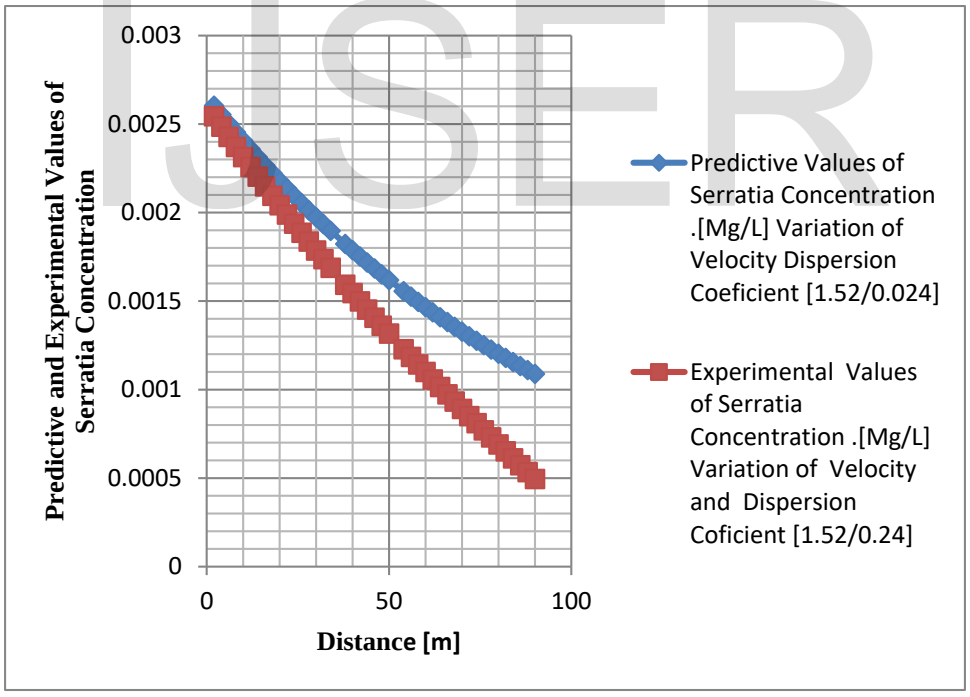

Figure 3: Predictive and Experimental Values for Serratia Concentration at Different Distance

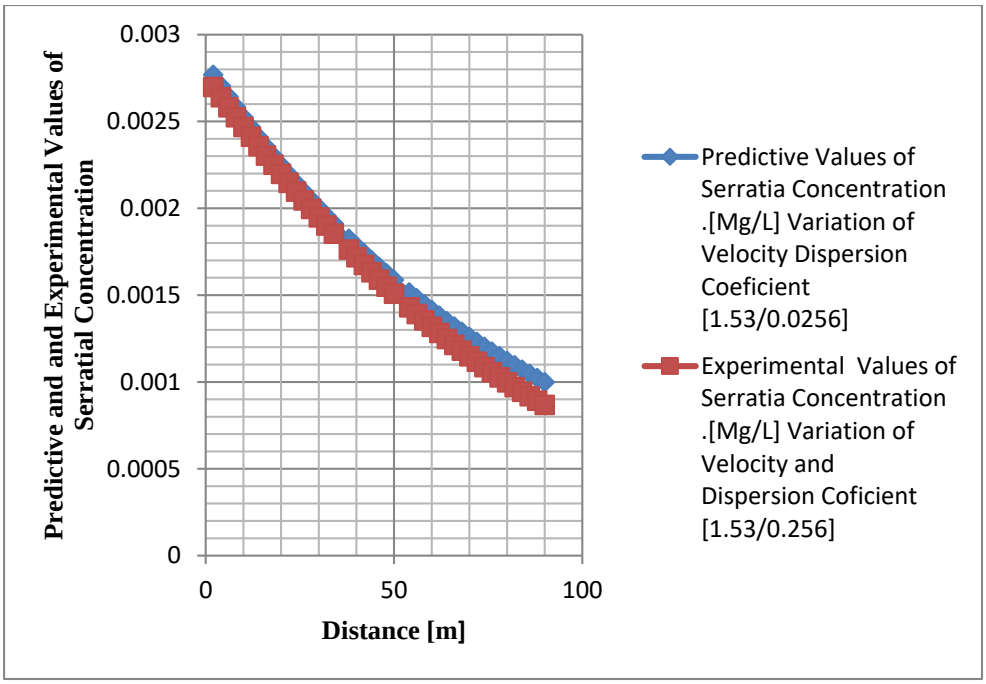

Figure 4: Predictive and Experimental Values for Serratia Concentration at Different Distance

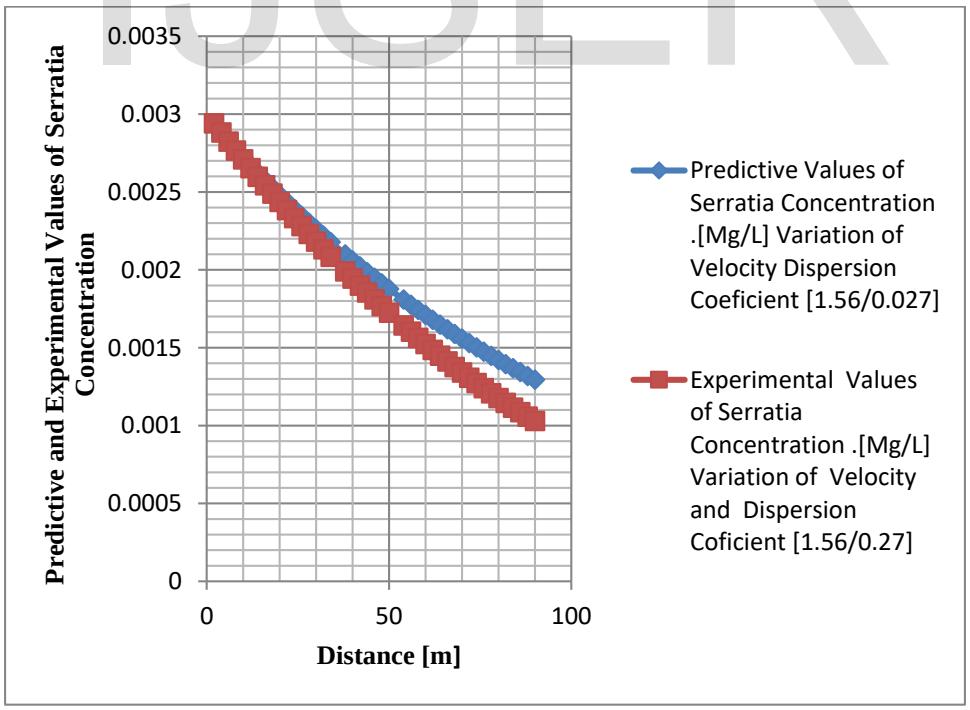

Figure 5: Predictive and Experimental Values for Serratia Concentration at Different Distance

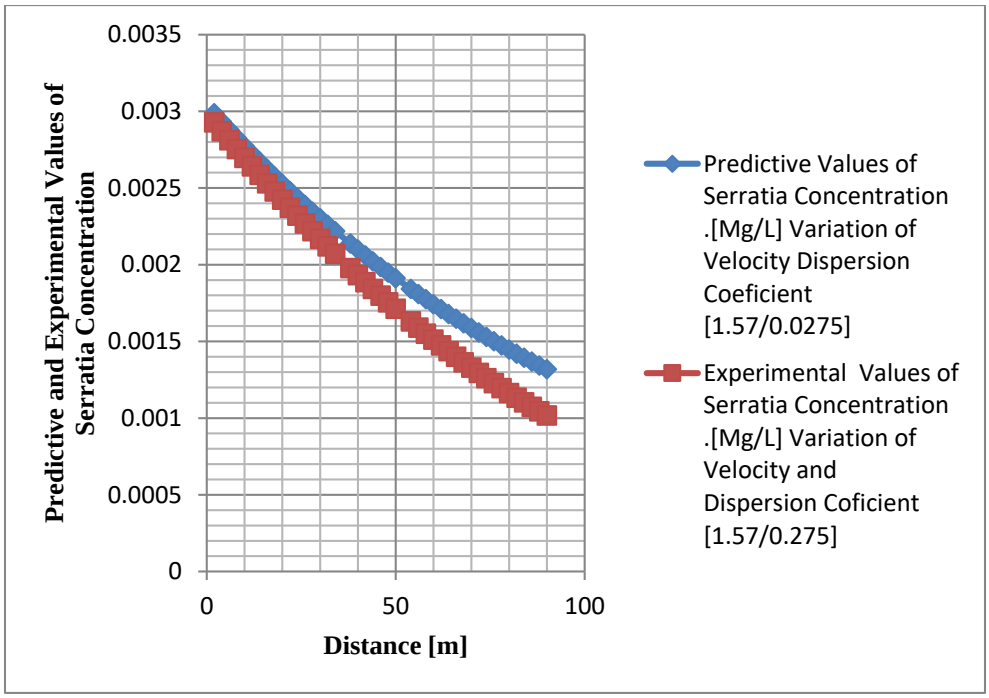

Figure 6: Predictive and Experimental Values for Serratia Concentration at Different Distance

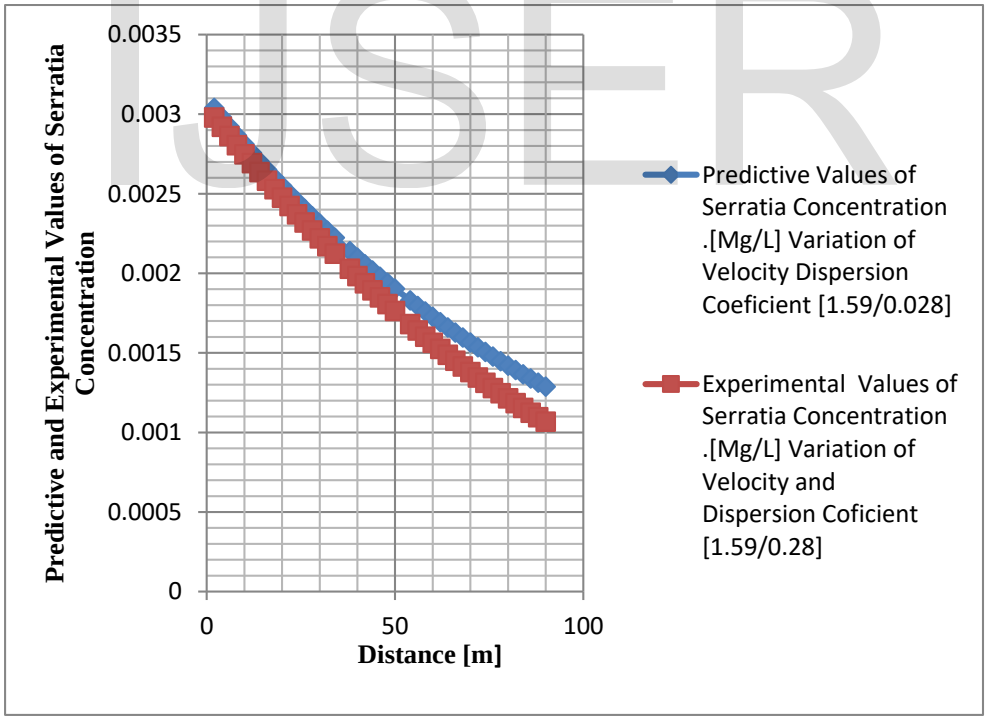

Figure 7: Predictive and Experimental Values for Serratia Concentration at Different Distance

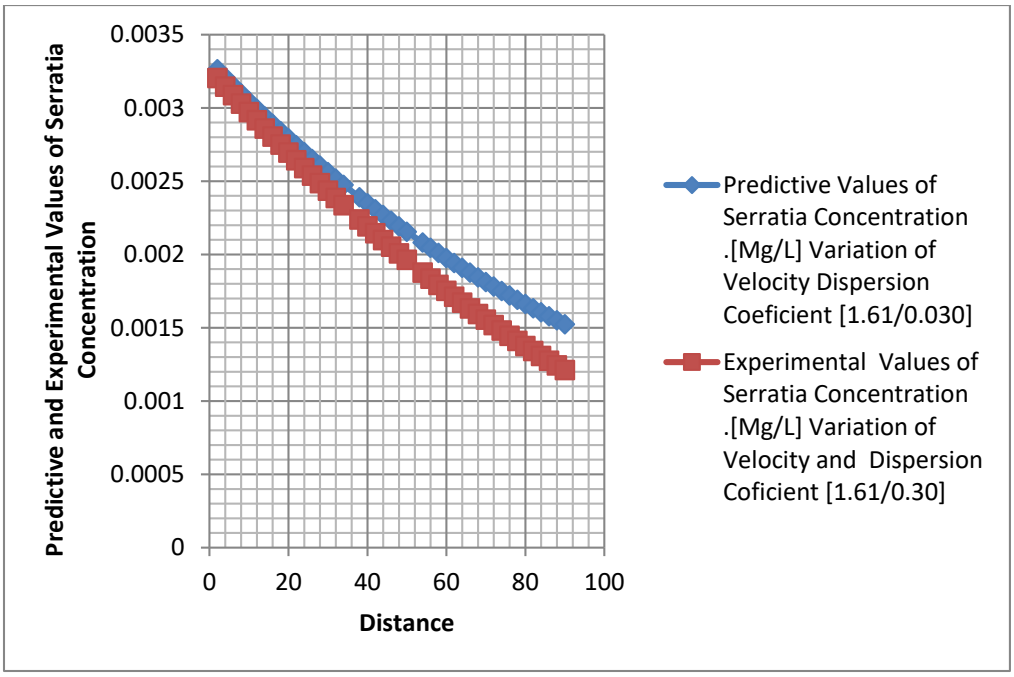

Figure 8: Predictive and Experimental Values for Serratia Concentration at Different Distance

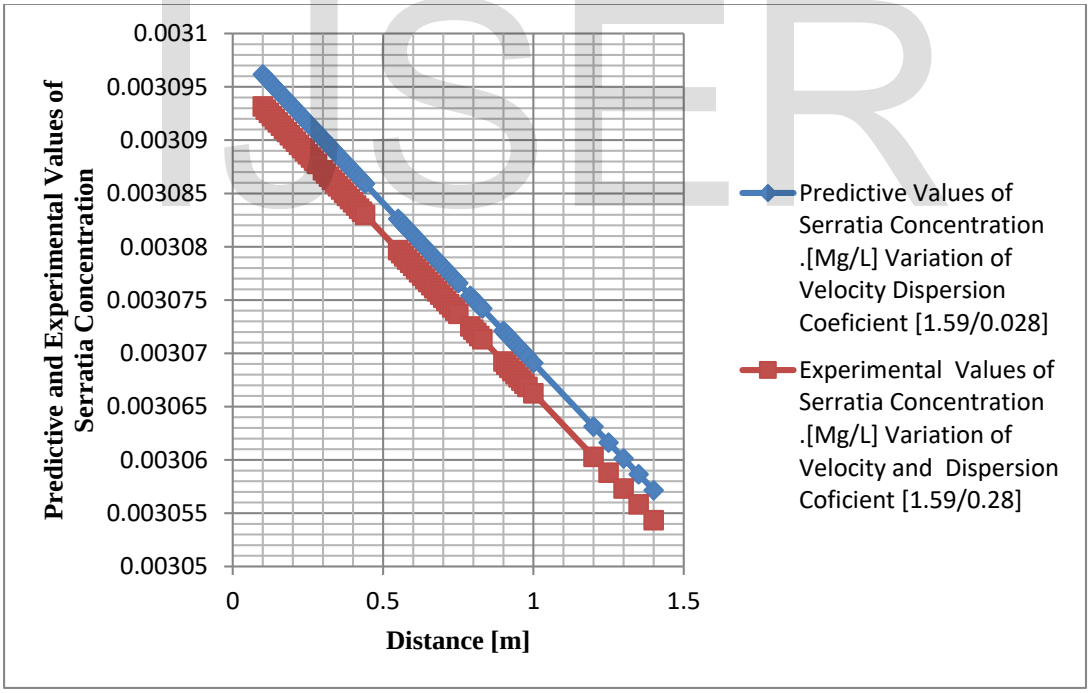

Figure 9: Predictive and Experimental Values for Serratia Concentration at Different Distance

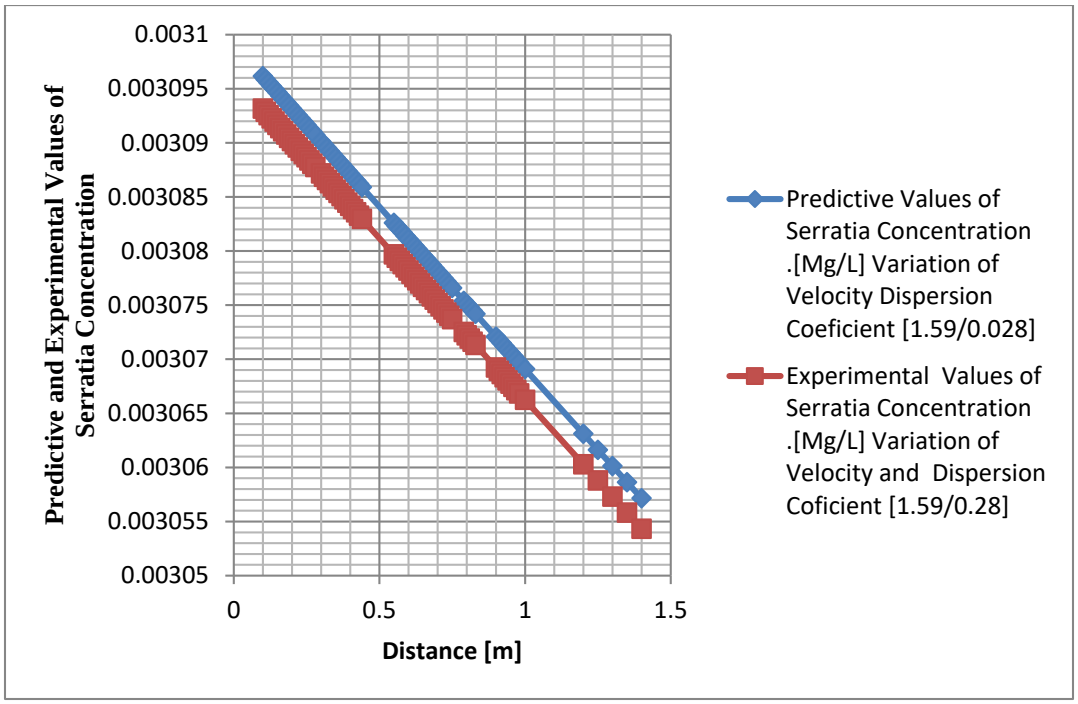

Figure 10: Predictive and Experimental Values for Serratia Concentration at Different Distance

Figure one to ten show how the systems were monitored on the transport of Serratia in the stream.The deposition of numerous microbes in the surface water was observed which could be attributed to the biological waste that are deposited in stream from the community settlers at different location of the stream.As the stream flows, contaminantsare moved and dispersed throughoutthe receiving body.The process of examining the stream was to determine some parameters that influence the growth rate of the microbes in the study environment,this generated some influential variables that affected the behaviour of the predominant microbes on study area. The study further investigated variations of therate of concentrations at different station points. The rate of dispersion wasalso monitored during the examination on the surface water, but wasdetermined on the rate of concentration within the stream.The contaminant spread was observed as there was no region of the stream where traces of the microbes was not experienced.The observed figures showed a decrease in concentration in all the station points based on the diffusion and dispersion, which was traced usingthe physiochemical Analysis.The graphical representation experienced decrease with respect to increase in distance, but observed some heterogeneity in some locations, these were observed in all the figures, but the system

maintained heterogeneity in few trends, whereby some figures experienced gradual decrease with respect to increase in distance, while other rapid decrease on linear trend were experience on the remaining trends,which was found to imply that the system was affected by heterogeneous conditions of diffusion, dispersion and stream velocity and their rates of concentration determined the level of influences from the observed parameters.The predictive was compared with the experimental Data, and both parameters developed a positive correlation.

5. Conclusion

The study examined the transport of Serratia in stream and observed influences such as environmental conditions and other factors. The study evaluates the observed parameters in the system, such as dispersions that influence the spread of the contaminant outside the station point of discharge in the study area. The predominant depositions of the microbes were based on these parameters that influence the transport process of the contaminant in the study area, heterogeneous stream velocity were monitored as the transport process experience variations in concentration with respect to distance, the rates of decrease with increase in distanced were all observed from the graphical representation in all the figures, their rates of concentration experienced variation as it is observed from the figures, the system monitored are based on these factors, the study however showed it decreased from the permissible limits as it does not meet the required standard specification. The diffusion in the system predominantly decreases the increase of the contaminant including stream velocity. The study through investigation on microbial and physiochemical analysis process found the behaviour of the contaminant based on these factors

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