Research Article
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Arsenic transport on velocity of flow pressured by variation of dispersion and diffusion in choba creek

Abstract

Diffusion and dispersion in Choba Creek were monitored using modeling and simulation under the influence of velocity. The study monitored the process of arsenic deposition at various discharge stations, where the contaminant was observed depositing different levels of concentration. This implies that the quality of the water in the creek has deposited arsenic as a substance in the environment, and the application of monitoring diffusion rate of arsenic are based on the heterogeneity of the velocity; the study using modeling and simulation were able to express the significant impact of diffusion, because the transport process experienced decrease in concentration with respect to increase in distance for all figures, These conditions imply that velocity in some locations exhibited very low in transport process, which would have resulted in arsenic accumulation in most location, this implies that the rates of concentration would have deposit exponential phase, but diffusion has exhibited higher significant impact compare to dispersion of arsenic. Predicting the Arsenic concentration in Choba Creek has demonstrated the rate of velocity and diffusion impact in the study area; as a result, discharge from some industries has increased the concentration of the contaminant, which this study has monitored the source and the rates of contaminant at different station points. The study is imperative because the contaminant's source has been investigated, the rate of pollution at different point sources has been assessed, and experts will undoubtedly use the transport model as a source for monitoring other creek contaminants, including various heavy metals, in any region of the nation.

Keywords: arsenic, transport, velocity, dispersion, diffusion

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Introduction

Arsenic in water poses a serious threat to people's health. Numerous cutaneous, gastrointestinal, neurological, and cardiovascular issues are brought on by exposure to this element. Following ingestion, arsenic's carcinogenic properties cause a number of malignancies, including skin, lung, and bladder cancers.[1] Arsenic contamination of water is a problem that exists around the world. Arsenic contamination affects nations from the west, including Argentina, the United States, and Canada, to the east, including Bangladesh, India, and China.[2] Aquifers, which are groundwater sources, are the bodies of water that are most negatively impacted by the issue of arsenic pollution. Arsenite (As (III)) and arsenate (As (V)) are the two main oxidation states of the oxy anions that make up the majority of the arsenic in such sources.[2] Although the presence of arsenic in the nearby bedrock allows it to naturally dissolve into these water sources, numerous human activities, such as mining, smelting, using coal for power generation, and using agricultural pesticides, can exacerbate arsenic contamination, particularly in parts of Asia.[3] The market offers a variety of water filters built on a variety of unique technologies. These processes include distillation, reverse osmosis (RO), activated carbon, activated alumina, and anion exchange. All other techniques, with the exception of RO and distillation, involve pushing polluted water through a porous medium comprised of beads or particles. The walls of porous media absorb the dissolved arsenic ions as the water comes into contact with them through processes like anion exchange or sorption. For this "catch," the high surface area of porous medium is helpful.

Convection-diffusion equations can be used to model this process because the tracer-type species transport equations can handle the migration and absorption of this element. The concentration of arsenic in water is typically measured in ppb or parts-per-billion (the acceptable concentration of arsenic in safe drinking water is less than 10 ppb). As a result, the modeling of arsenic transit and capture in groundwater and any commercially available water filter for arsenic are relatively similar. We shall draw ideas and strategies for resolving this issue in filters from the fairly well-researched issue of arsenic pollution of groundwater (or by any other toxic heavy metal such as lead). Groundwater pollution is a well-researched issue in the domains of environmental engineering, soil sciences, geosciences, and subsurface hydrology. Aquifers are the enormous porous bodies, comprised of sand or other similar particulate matter stuck between layers of rocks, it contain a significant amount of groundwater. These aquifers are penetrated by the wells to obtain the water needed for human consumption. Due to the water exchanged between these aquifers and streams, rivers, and ponds, the contamination in these water bodies frequently finds its way into the aquifers. Additionally, buried radioactive, chemical, and other types of waste have the potential to contaminate the aquifers.

Due to ion absorption by solid particles and bacterial action, the contaminated water passing through the porous aquifer can be filtered. As a result, during groundwater movement, the concentration of pollutants may alter across time and geography. Scientists in various nations are working to solve the significant problem of predicting aquifer pollution. Darcy's law is used to simulate the movement of water within aquifers, and the convection-dispersion equation is used to simulate the movement of pollutants as a result of adsorption and biological activity.[4,34] As mentioned earlier, the physics for modeling the transport and adsorption of contaminants is exactly identical to the transport and adsorption of arsenic in a water filter. Here we will describe the work that has already been done in this area as well as the limitation of that work. Numerous analytical solutions have been developed for modeling solute transport through fully-saturated aquifers.[5–17] However, there are some shortcomings associated with them. For example, the dispersion tensor is simplified without any justification-it is merely presented as a constitutive relation without any correlation with the pore-scale microstructure and the phenomena occurring therein.[4] Several times, the dispersion tensor is overly simplified after dropping the molecular diffusivity contribution[5,7,10] or simply treated as a constant.[8,12,14]

The transport of solute in naturally occurring porous formations, such as aquifers with variable permeability, has, nevertheless, been the subject of various stochastic groundwater modeling methodologies that have been presented.[18–20] According to Dagan,[19] convection and the spatial variability of permeability play a significant role in controlling the spatial distribution of solute in such porous structures. Due to the smallness of the transverse dispersivity in relation to the heterogeneity scale, the marginal influence of pore-scale dispersion is typically ignored in these situations. In order to advance this research,[19] Aldo[20] looked into the effects of the pore-scale dispersion mechanism in a heterogeneous aquifer under both ergodic and nonergodic transport conditions. To model the movement of tracer species in the same way, Rubin[21] published stochastic versions of the advection-dispersion equation including heterogeneous media with pores. These mathematical models frequently seek geostatistical characteristics for stochastic modeling and are based on the assumptions of stationary, ergodicity, and gaussian distribution. These methods have had some degree of success in linking various length scales and in foretelling the outcomes of sizable controlled field studies.[22,23] They still require improvement because they are unable to take into consideration the impact of pore-level microstructural features in the calculation of the total dispersion tensor.

In the below-described proposed research, we will create a more thorough analysis for species movement utilizing a micro-macro coupling that can eliminate the aforementioned flaws and result in a significant advancement in this field. A reliable way for scaling up from the pore scale to the macroscopic lab or field scale is the method of volume averaging.[24–26] A brief history of this method's application in comprehending and forecasting mass transportation in porous material is provided here. Whitaker made one of the earliest attempts to comprehend and simulate hydrodynamic dispersion and diffusion in porous medium.[27] By recommending the estimation of the deviations from the intrinsic phase-average (instead of the phase-average) for the concentration of the solute, Gray later[28] provided an improvement to Whitaker's approach. The Taylor Aries model was confirmed as a result of efforts to comprehend hydrodynamic dispersion in capillary tubes that represented porous media.[29] Later, the same principles were used to create a one-Equation[30] and a two-Equation[31] model for solute transport combined with adsorption in heterogeneous porous media with a dual length scale. The effective dispersion tensor in a heterogeneous medium was then determined using an adaptation of the volume averaging method, and the results were verified using the ensemble averaging procedure.[32] The effects of the Péclet number, permeability ratio, and local-scale dispersivity on the dispersion coefficient were investigated using parametric analysis.[33] The macroscopic characteristics of a perfect heterogeneous porous media were later ascertained using the two-equation model.

Theoretical background

$$\frac{dC}{dX} + B(X)C_0 K = A(X) \qquad (1)$$

Nomenclature

C= Arsenic Concentration

K= Velocities

C_0 **= Diffusion**

B = Dispersion Coefficients

A= Constant

Multiplying (1) Through by P(x)

$$P(x)\frac{dC}{dX} + B(x)C_0 KP(x) = A(x)P(x) \qquad (2)$$

Let $P^1 = B(x)CKP(x) = A(x)P(x)$ (2ndTerm LHS)

$$\text{P(x)}\frac{dC}{dx} + P^1(x)C_0 K = A(x)P(x)$$

$$\frac{dC}{dx}(\text{C}_0 PK) = A(\text{x})P(\text{x})$$

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

Similarly;Let $P(x) = A(x)C_0 P(x)$

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

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

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

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

Integrate both sides, gives:

$\ln C = (A(x)\text{-}B(x)\ K)x + C_1$

C = D*exp $(\mathrm{A}(x) - \mathrm{B}(x)\mathrm{K})x$

Materials and method

Standard laboratory experiments were carried out to determine the rate of Arsenic transport at various formations. The strata depositions were collected in sequences based on structural deposition at various study areas. Through its pressure flow at the lower end of the column, the samples collected at different locations produced variation in concentration at different depths. For model validation, the experimental results were applied and compared to theoretical values.

Results and discussion

Results and discussion are presented in tables including graphical representation of heterogeneous depositions on Arsenic concentration at different depths (Tables 1–10).

The study observed the transport of the substance based on the velocity of flow in the creek. The study looked at the impact of the creek's velocity of flow, which was found to be heterogeneous based on several factors. Figures 1–10 explained the transport process of

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arsenic in Choba Creek; the study monitored the deposition source of arsenic in the creek through monitoring the rates of concentration in different locations. The velocity of the creek as it was examined determined the rates of concentration at those station points. The industry within the study environment was found to generate a high rate of negative impact in the creek, due to the discharge of various chemical effluents from the industries. These are based on the rate of constant regenerations of Arsenic in the creek observed at various station points, the behavior of the system in terms of concentration were monitored in various locations, the study has explained the influence from diffusion and heterogeneous velocity of the creek, but due to high rate diffusion in the creek, the rate of concentration of arsenic influenced the decrease in concentration with respect to distance of different location in the creek, the velocity of flow. Based on the fact that the metal experienced concentration reduction rather than accumulation, the condition implies that the rate of velocity of flow experienced heterogeneity, implying that there it should have been an accumulation in those locations that experienced high decreases in velocity at the point of discharge, with this trend experiencing such decrease in concentration influenced by two parameters expressed their rates of significant in the system. The observed predictive and experimental experienced best fits correlation.

Table 1 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0042-0.029]	Experimental values of Arsenic (As), Conc.[Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0042]
0.1	0.106833129	0.1065
0.11	0.106806478	0.10648
0.12	0.106779834	0.10646
0.13	0.106753197	0.10644
0.14	0.106726567	0.10642
0.15	0.106699943	0.1064
0.16	0.106673325	0.10638
0.17	0.106646715	0.10636
0.18	0.106620111	0.10634
0.19	0.106593513	0.10632
0.2	0.106566923	0.1063
0.21	0.106540338	0.10628
0.22	0.106513761	0.10626
0.23	0.10648719	0.10624
0.24	0.106460626	0.10622
0.25	0.106434068	0.1062
0.26	0.106407517	0.10618
0.27	0.106380973	0.10616
0.28	0.106354435	0.10614
0.3	0.10630138	0.1061
0.31	0.106274862	0.10608
0.32	0.10624835	0.10606
0.33	0.106221846	0.10604
0.34	0.106195348	0.10602
0.35	0.106168856	0.106
0.36	0.106142372	0.10598
0.37	0.106115893	0.10596
0.38	0.106089422	0.10594
0.39	0.106062957	0.10592
0.4	0.106036498	0.1059
0.41	0.106010047	0.10588
0.42	0.105983601	0.10586
0.43	0.105957163	0.10584
0.44	0.105930731	0.10582
0.55	0.105640414	0.1056
0.56	0.105614061	0.10558
0.57	0.105587714	0.10556
0.58	0.105561374	0.10554
0.59	0.105535041	0.10552
0.6	0.105508714	0.1055
0.61	0.105482394	0.10548
0.62	0.105456081	0.10546
0.63	0.105429774	0.10544
0.64	0.105403473	0.10542
0.65	0.105377179	0.1054
0.66	0.105350892	0.10538
0.67	0.105324611	0.10536
0.68	0.105298337	0.10534
0.69	0.105272069	0.10532
0.7	0.105245808	0.1053
0.71	0.105219554	0.10528
0.72	0.105193306	0.10526
0.73	0.105167064	0.10524
0.74	0.105140829	0.10522
0.75	0.105114601	0.1052
0.79	0.105009753	0.10512
0.8	0.104983557	0.1051
0.81	0.104957368	0.10508
0.82	0.104931185	0.10506
0.83	0.104905009	0.10504
0.9	0.10472196	0.1049
0.91	0.104695836	0.10488
0.92	0.104669718	0.10486
0.93	0.104643608	0.10484
0.94	0.104617503	0.10482
0.95	0.104591406	0.1048
0.96	0.104565314	0.10478
0.97	0.104539229	0.10476
0.98	0.104513151	0.10474
1	0.104461014	0.1047
1.2	0.103941072	0.1043
1.25	0.103811491	0.1042
1.3	0.103682072	0.1041
1.35	0.103552814	0.104
1.4	0.103423717	0.1039
1.5	0.103166007	0.1037

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Table 2 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0039-0.039]	Experimental values of Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0039]
0.1	0.08139667	0.08119667
0.11	0.081376364	0.08117667
0.12	0.081356064	0.08115667
0.13	0.081335769	0.08113667
0.14	0.081315479	0.08111667
0.15	0.081295194	0.08109667
0.16	0.081274915	0.08107667
0.17	0.08125464	0.08105667
0.18	0.08123437	0.08103667
0.19	0.081214105	0.08101667
0.2	0.081193846	0.08099667
0.21	0.081173591	0.08097667
0.22	0.081153342	0.08095667
0.23	0.081133097	0.08093667
0.24	0.081112858	0.08091667
0.25	0.081092623	0.08089667
0.26	0.081072394	0.08087667
0.27	0.08105217	0.08085667
0.28	0.081031951	0.08083667
0.3	0.080991527	0.08079667
0.31	0.080971323	0.08077667
0.32	0.080951124	0.08075667
0.33	0.08093093	0.08073667
0.34	0.080910741	0.08071667
0.35	0.080890557	0.08069667
0.36	0.080870378	0.08067667
0.37	0.080850204	0.08065667
0.38	0.080830036	0.08063667
0.39	0.080809872	0.08061667
0.4	0.080789713	0.08059667
0.41	0.080769559	0.08057667
0.42	0.080749411	0.08055667
0.43	0.080729267	0.08053667
0.44	0.080709128	0.08051667
0.55	0.080487934	0.08029667
0.56	0.080467856	0.08027667
0.57	0.080447782	0.08025667
0.58	0.080427714	0.08023667
0.59	0.08040765	0.08021667
0.6	0.080387592	0.08019667
0.61	0.080367538	0.08017667
0.62	0.08034749	0.08015667
0.63	0.080327447	0.08013667
0.64	0.080307408	0.08011667
0.65	0.080287375	0.08009667
0.66	0.080267346	0.08007667
0.67	0.080247323	0.08005667
0.68	0.080227304	0.08003667
0.69	0.080207291	0.08001667
0.7	0.080187282	0.07999667
0.71	0.080167279	0.07997667
0.72	0.08014728	0.07995667
0.73	0.080127287	0.07993667
0.74	0.080107299	0.07991667
0.75	0.080087315	0.07989667
0.79	0.080007431	0.07981667
0.8	0.079987472	0.07979667
0.81	0.079967519	0.07977667
0.82	0.07994757	0.07975667
0.83	0.079927626	0.07973667
0.9	0.07978816	0.07959667
0.91	0.079768256	0.07957667
0.92	0.079748357	0.07955667
0.93	0.079728463	0.07953667
0.94	0.079708574	0.07951667
0.95	0.07968869	0.07949667
0.96	0.079668811	0.07947667
0.97	0.079648937	0.07945667
0.98	0.079629068	0.07943667
1	0.079589344	0.07939667
1.2	0.079193198	0.07899667
1.25	0.079094469	0.07889667
1.3	0.078995864	0.07879667
1.35	0.078897382	0.07869667
1.4	0.078799023	0.07859667
1.5	0.078602672	0.07839667

Table 3 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1153/0.0041-0.0027]	Experimental values of Arsenic (As), Conc.[Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.153/0.0029-0.0041]
0.1	0.053448441	0.053438441
0.11	0.053438295	0.053436341
0.12	0.053428152	0.053434041
0.13	0.05341801	0.053431541
0.14	0.053407871	0.053428841
0.15	0.053397733	0.053425941
0.16	0.053387597	0.053422841
0.17	0.053377464	0.053419541
0.18	0.053367332	0.053416041
0.19	0.053357202	0.053412341
0.2	0.053347074	0.053408441
0.21	0.053336948	0.053404341
0.22	0.053326824	0.053400041
0.23	0.053316701	0.053395541
0.24	0.053306581	0.053390841
0.25	0.053296463	0.053385941
0.26	0.053286346	0.053380841
0.27	0.053276231	0.053375541
0.28	0.053266119	0.053370041
0.3	0.053245899	0.053358441
0.31	0.053235792	0.053352341
0.32	0.053225687	0.053346041
0.33	0.053215584	0.053339541
0.34	0.053205483	0.053332841
0.35	0.053195384	0.053325941
0.36	0.053185287	0.053318841
0.37	0.053175191	0.053311541
0.38	0.053165098	0.053304041
0.39	0.053155006	0.053296341
0.4	0.053144917	0.053288441
0.41	0.053134829	0.053280341
0.42	0.053124743	0.053272041
0.43	0.053114659	0.053263541
0.44	0.053104577	0.053254841
0.55	0.052993802	0.053145941
0.56	0.052983743	0.053134841
0.57	0.052973685	0.053123541
0.58	0.05296363	0.053112041
0.59	0.052953577	0.053100341
0.6	0.052943525	0.053088441
0.61	0.052933476	0.053076341
0.62	0.052923428	0.053064041
0.63	0.052913383	0.053051541
0.64	0.052903339	0.053038841
0.65	0.052893297	0.053025941
0.66	0.052883257	0.053012841
0.67	0.052873219	0.052999541
0.68	0.052863183	0.052986041
0.69	0.052853149	0.052972341
0.7	0.052843116	0.052958441
0.71	0.052833086	0.052944341
0.72	0.052823057	0.052930041
0.73	0.052813031	0.052915541
0.74	0.052803006	0.052900841
0.75	0.052792983	0.052885941
0.79	0.052752911	0.052824341
0.8	0.052742897	0.052808441
0.81	0.052732886	0.052792341
0.82	0.052722877	0.052776041
0.83	0.052712869	0.052759541
0.9	0.052642869	0.052638441
0.91	0.052632876	0.052620341
0.92	0.052622886	0.052602041
0.93	0.052612897	0.052583541
0.94	0.05260291	0.052564841
0.95	0.052592926	0.052545941
0.96	0.052582943	0.052526841
0.97	0.052572962	0.052507541
0.98	0.052562982	0.052488041
1	0.05254303	0.052448441
1.2	0.052343919	0.052008441
1.25	0.05229426	0.051885941
1.3	0.052244647	0.051758441
1.35	0.052195082	0.051625941
1.4	0.052145564	0.051488441
1.5	0.052046668	0.051198441

Table 4 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0039-0.039]	Experimental values of Arsenic (As), Conc.[Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0039]
0.1	0.066134827	0.0659
0.11	0.066118333	0.06589
0.12	0.066101842	0.06588
0.13	0.066085356	0.06587
0.14	0.066068873	0.06586
0.15	0.066052395	0.06585
0.16	0.066035921	0.06584
0.17	0.066019451	0.06583
0.18	0.066002985	0.06582
0.19	0.065986524	0.06581
0.2	0.065970066	0.0658
0.21	0.065953612	0.06579
0.22	0.065937163	0.06578
0.23	0.065920718	0.06577
0.24	0.065904276	0.06576
0.25	0.065887839	0.06575
0.26	0.065871406	0.06574
0.27	0.065854977	0.06573
0.28	0.065838553	0.06572
0.3	0.065805715	0.0657
0.31	0.065789303	0.06569
0.32	0.065772894	0.06568
0.33	0.06575649	0.06567
0.34	0.06574009	0.06566
0.35	0.065723693	0.06565
0.36	0.065707301	0.06564
0.37	0.065690913	0.06563
0.38	0.065674529	0.06562
0.39	0.06565815	0.06561
0.4	0.065641774	0.0656
0.41	0.065625402	0.06559
0.42	0.065609035	0.06558
0.43	0.065592671	0.06557
0.44	0.065576312	0.06556
0.55	0.065396627	0.06545
0.56	0.065380317	0.06544
0.57	0.06536401	0.06543
0.58	0.065347708	0.06542
0.59	0.06533141	0.06541
0.6	0.065315115	0.0654
0.61	0.065298825	0.06539
0.62	0.065282539	0.06538
0.63	0.065266257	0.06537
0.64	0.065249979	0.06536
0.65	0.065233705	0.06535
0.66	0.065217435	0.06534
0.67	0.065201169	0.06533
0.68	0.065184908	0.06532
0.69	0.06516865	0.06531
0.7	0.065152396	0.0653
0.71	0.065136147	0.06529
0.72	0.065119901	0.06528
0.73	0.06510366	0.06527
0.74	0.065087422	0.06526
0.75	0.065071189	0.06525
0.79	0.065006296	0.06521
0.8	0.064990082	0.0652
0.81	0.064973873	0.06519
0.82	0.064957668	0.06518
0.83	0.064941467	0.06517
0.9	0.064828173	0.0651
0.91	0.064812004	0.06509
0.92	0.06479584	0.06508
0.93	0.064779679	0.06507
0.94	0.064763522	0.06506
0.95	0.06474737	0.06505
0.96	0.064731221	0.06504
0.97	0.064715077	0.06503
0.98	0.064698936	0.06502
1	0.064666667	0.065
1.2	0.064344861	0.0648
1.25	0.06426466	0.06475
1.3	0.064184559	0.0647
1.35	0.064104558	0.06465
1.4	0.064024657	0.0646
1.5	0.063865152	0.0645

Table 5 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0039-0.039]	Experimental values of Arsenic (As), Conc.[Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0039]
0.1	0.0635911	0.0634
0.11	0.063575232	0.06339
0.12	0.063559368	0.06338
0.13	0.063543507	0.06337
0.14	0.063527651	0.06336
0.15	0.063511799	0.06335
0.16	0.06349595	0.06334
0.17	0.063480106	0.06333
0.18	0.063464265	0.06332
0.19	0.063448429	0.06331
0.2	0.063432596	0.0633
0.21	0.063416768	0.06329
0.22	0.063400943	0.06328
0.23	0.063385122	0.06327
0.24	0.063369305	0.06326
0.25	0.063353493	0.06325
0.26	0.063337684	0.06324
0.27	0.063321879	0.06323
0.28	0.063306078	0.06322
0.3	0.063274488	0.0632
0.31	0.063258698	0.06319
0.32	0.063242913	0.06318
0.33	0.063227132	0.06317
0.34	0.063211355	0.06316
0.35	0.063195581	0.06315
0.36	0.063179812	0.06314
0.37	0.063164046	0.06313
0.38	0.063148284	0.06312
0.39	0.063132527	0.06311
0.4	0.063116773	0.0631
0.41	0.063101023	0.06309
0.42	0.063085277	0.06308
0.43	0.063069535	0.06307
0.44	0.063053797	0.06306
0.55	0.062880938	0.06295
0.56	0.062865247	0.06294
0.57	0.06284956	0.06293
0.58	0.062833877	0.06292
0.59	0.062818197	0.06291
0.6	0.062802522	0.0629
0.61	0.062786851	0.06289
0.62	0.062771183	0.06288
0.63	0.06275552	0.06287
0.64	0.06273986	0.06286
0.65	0.062724204	0.06285
0.66	0.062708552	0.06284
0.67	0.062692904	0.06283
0.68	0.06267726	0.06282
0.69	0.06266162	0.06281
0.7	0.062645984	0.0628
0.71	0.062630351	0.06279
0.72	0.062614723	0.06278
0.73	0.062599098	0.06277
0.74	0.062583478	0.06276
0.75	0.062567861	0.06275
0.79	0.062505433	0.06271
0.8	0.062489836	0.0627
0.81	0.062474242	0.06269
0.82	0.062458653	0.06268
0.83	0.062443067	0.06267
0.9	0.062334077	0.0626
0.91	0.062318522	0.06259
0.92	0.062302972	0.06258
0.93	0.062287425	0.06257
0.94	0.062271882	0.06256
0.95	0.062256343	0.06255
0.96	0.062240808	0.06254
0.97	0.062225277	0.06253
0.98	0.062209749	0.06252
1	0.062178706	0.0625
1.2	0.061869126	0.0623
1.25	0.061791972	0.06225
1.3	0.061714914	0.0622
1.35	0.061637953	0.06215
1.4	0.061561087	0.0621
1.5	0.061407643	0.062

Table 6 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0042-0.029]	Experimental Values of Arsenic (As), Conc.[Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0042]
0.1	0.106833152	0.1066
0.11	0.106806504	0.10658
0.12	0.106779862	0.10656
0.13	0.106753227	0.10654
0.14	0.106726599	0.10652
0.15	0.106699977	0.1065
0.16	0.106673362	0.10648
0.17	0.106646754	0.10646
0.18	0.106620152	0.10644
0.19	0.106593557	0.10642
0.2	0.106566969	0.1064
0.21	0.106540387	0.10638
0.22	0.106513812	0.10636
0.23	0.106487243	0.10634
0.24	0.106460681	0.10632
0.25	0.106434126	0.1063
0.26	0.106407577	0.10628
0.27	0.106381035	0.10626
0.28	0.1063545	0.10624
0.3	0.106301449	0.1062
0.31	0.106274933	0.10618
0.32	0.106248424	0.10616
0.33	0.106221922	0.10614
0.34	0.106195426	0.10612
0.35	0.106168937	0.1061
0.36	0.106142454	0.10608
0.37	0.106115978	0.10606
0.38	0.106089509	0.10604
0.39	0.106063046	0.10602
0.4	0.10603659	0.106
0.41	0.10601014	0.10598
0.42	0.105983698	0.10596
0.43	0.105957261	0.10594
0.44	0.105930831	0.10592
0.55	0.105640539	0.1057
0.56	0.105614188	0.10568
0.57	0.105587844	0.10566
0.58	0.105561507	0.10564
0.59	0.105535176	0.10562
0.6	0.105508851	0.1056
0.61	0.105482533	0.10558
0.62	0.105456222	0.10556
0.63	0.105429917	0.10554
0.64	0.105403619	0.10552
0.65	0.105377327	0.1055
0.66	0.105351042	0.10548
0.67	0.105324764	0.10546
0.68	0.105298492	0.10544
0.69	0.105272226	0.10542
0.7	0.105245967	0.1054
0.71	0.105219715	0.10538
0.72	0.105193469	0.10536
0.73	0.10516723	0.10534
0.74	0.105140997	0.10532
0.75	0.105114771	0.1053
0.79	0.105009932	0.10522
0.8	0.104983739	0.1052
0.81	0.104957552	0.10518
0.82	0.104931372	0.10516
0.83	0.104905198	0.10514
0.9	0.104722163	0.105
0.91	0.104696042	0.10498
0.92	0.104669927	0.10496
0.93	0.104643818	0.10494
0.94	0.104617716	0.10492
0.95	0.10459162	0.1049
0.96	0.104565531	0.10488
0.97	0.104539449	0.10486
0.98	0.104513373	0.10484
1	0.10446124	0.1048
1.12	0.10414899	0.10456
1.14	0.104097039	0.10452
1.16	0.104045114	0.10448
1.18	0.103993215	0.10444
1.2	0.103941341	0.1044
1.22	0.103889494	0.10436

Table 7 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0039-0.039]	Experimental Values of Arsenic (As), Conc.[Mg/l] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0039]
0.1	0.081396317	0.081196317
0.11	0.081375977	0.081176317
0.12	0.081355641	0.081156317
0.13	0.081335311	0.081136317
0.14	0.081314986	0.081116317
0.15	0.081294666	0.081096317
0.16	0.081274351	0.081076317
0.17	0.081254041	0.081056317
0.18	0.081233737	0.081036317
0.19	0.081213437	0.081016317
0.2	0.081193142	0.080996317
0.21	0.081172853	0.080976317
0.22	0.081152568	0.080956317
0.23	0.081132289	0.080936317
0.24	0.081112015	0.080916317
0.25	0.081091745	0.080896317
0.26	0.081071481	0.080876317
0.27	0.081051222	0.080856317
0.28	0.081030968	0.080836317
0.3	0.080990475	0.080796317
0.31	0.080970236	0.080776317
0.32	0.080950002	0.080756317
0.33	0.080929773	0.080736317
0.34	0.08090955	0.080716317
0.35	0.080889331	0.080696317
0.36	0.080869117	0.080676317
0.37	0.080848909	0.080656317
0.38	0.080828705	0.080636317
0.39	0.080808507	0.080616317
0.4	0.080788313	0.080596317
0.41	0.080768125	0.080576317
0.42	0.080747942	0.080556317
0.43	0.080727763	0.080536317
0.44	0.08070759	0.080516317
0.55	0.080486017	0.080296317
0.56	0.080465904	0.080276317
0.57	0.080445796	0.080256317
0.58	0.080425693	0.080236317
0.59	0.080405595	0.080216317
0.6	0.080385503	0.080196317
0.61	0.080365415	0.080176317
0.62	0.080345332	0.080156317
0.63	0.080325255	0.080136317
0.64	0.080305182	0.080116317
0.65	0.080285114	0.080096317
0.66	0.080265052	0.080076317
0.67	0.080244994	0.080056317
0.68	0.080224941	0.080036317
0.69	0.080204894	0.080016317
0.7	0.080184851	0.079996317
0.71	0.080164814	0.079976317
0.72	0.080144781	0.079956317
0.73	0.080124753	0.079936317
0.74	0.080104731	0.079916317
0.75	0.080084713	0.079896317
0.79	0.080004693	0.079816317
0.8	0.079984701	0.079796317
0.81	0.079964713	0.079776317
0.82	0.07994473	0.079756317
0.83	0.079924753	0.079736317
0.9	0.079785049	0.079596317
0.91	0.079765112	0.079576317
0.92	0.079745179	0.079556317
0.93	0.079725251	0.079536317
0.94	0.079705329	0.079516317
0.95	0.079685411	0.079496317
0.96	0.079665498	0.079476317
0.97	0.07964559	0.079456317
0.98	0.079625688	0.079436317
1	0.079585897	0.079396317
1.12	0.07934757	0.079156317
1.14	0.079307918	0.079116317
1.16	0.079268286	0.079076317
1.18	0.079228674	0.079036317
1.2	0.079189081	0.078996317
1.22	0.079149509	0.078956317

Table 8 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1153/0.0041-0.0027]	Experimental values of Arsenic (As), Conc. [Mg/l] variation of dispersion coefficient and heterogeneous velocity [1.153/0.0029-0.0041]
0.1	0.053448616	0.053438616
0.11	0.053438488	0.053436516
0.12	0.053428363	0.053434216
0.13	0.053418239	0.053431716
0.14	0.053408117	0.053429016
0.15	0.053397996	0.053426116
0.16	0.053387878	0.053423016
0.17	0.053377762	0.053419716
0.18	0.053367648	0.053416216
0.19	0.053357535	0.053412516
0.2	0.053347425	0.053408616
0.21	0.053337316	0.053404516
0.22	0.053327209	0.053400216
0.23	0.053317104	0.053395716
0.24	0.053307001	0.053391016
0.25	0.053296901	0.053386116
0.26	0.053286801	0.053381016
0.27	0.053276704	0.053375716
0.28	0.053266609	0.053370216
0.3	0.053246424	0.053358616
0.31	0.053236335	0.053352516
0.32	0.053226247	0.053346216
0.33	0.053216162	0.053339716
0.34	0.053206078	0.053333016
0.35	0.053195996	0.053326116
0.36	0.053185916	0.053319016
0.37	0.053175838	0.053311716
0.38	0.053165762	0.053304216
0.39	0.053155688	0.053296516
0.4	0.053145615	0.053288616
0.41	0.053135545	0.053280516
0.42	0.053125477	0.053272216
0.43	0.05311541	0.053263716
0.44	0.053105345	0.053255016
0.55	0.05299476	0.053146116
0.56	0.052984718	0.053135016
0.57	0.052974678	0.053123716
0.58	0.05296464	0.053112216
0.59	0.052954604	0.053100516
0.6	0.05294457	0.053088616
0.61	0.052934537	0.053076516
0.62	0.052924507	0.053064216
0.63	0.052914478	0.053051716
0.64	0.052904452	0.053039016
0.65	0.052894427	0.053026116
0.66	0.052884404	0.053013016
0.67	0.052874384	0.052999716
0.68	0.052864365	0.052986216
0.69	0.052854347	0.052972516
0.7	0.052844332	0.052958616
0.71	0.052834319	0.052944516
0.72	0.052824307	0.052930216
0.73	0.052814298	0.052915716
0.74	0.05280429	0.052901016
0.75	0.052794285	0.052886116
0.79	0.052754281	0.052824516
0.8	0.052744285	0.052808616
0.81	0.05273429	0.052792516
0.82	0.052724298	0.052776216
0.83	0.052714307	0.052759716
0.9	0.052644426	0.052638616
0.91	0.052634451	0.052620516
0.92	0.052624477	0.052602216
0.93	0.052614506	0.052583716
0.94	0.052604536	0.052565016
0.95	0.052594568	0.052546116
0.96	0.052584602	0.052527016
0.97	0.052574638	0.052507716
0.98	0.052564676	0.052488216
1	0.052544757	0.052448616
1.12	0.052425403	0.052194216
1.14	0.052405537	0.052149016
1.16	0.052385679	0.052103016
1.18	0.052365828	0.052056216
1.2	0.052345984	0.052008616
1.22	0.052326148	0.051960216

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Table 9 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0039-0.039]	Experimental values of Arsenic (As), Conc. [Mg/l] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0039]
0.1	0.066135113	0.0659
0.11	0.066118646	0.06589
0.12	0.066102184	0.06588
0.13	0.066085726	0.06587
0.14	0.066069273	0.06586
0.15	0.066052823	0.06585
0.16	0.066036377	0.06584
0.17	0.066019936	0.06583
0.18	0.066003498	0.06582
0.19	0.065987065	0.06581
0.2	0.065970635	0.0658
0.21	0.06595421	0.06579
0.22	0.065937789	0.06578
0.23	0.065921372	0.06577
0.24	0.065904959	0.06576
0.25	0.06588855	0.06575
0.26	0.065872145	0.06574
0.27	0.065855745	0.06573
0.28	0.065839348	0.06572
0.3	0.065806567	0.0657
0.31	0.065790183	0.06569
0.32	0.065773802	0.06568
0.33	0.065757426	0.06567
0.34	0.065741054	0.06566
0.35	0.065724686	0.06565
0.36	0.065708322	0.06564
0.37	0.065691962	0.06563
0.38	0.065675606	0.06562
0.39	0.065659255	0.06561
0.4	0.065642907	0.0656
0.41	0.065626563	0.06559
0.42	0.065610224	0.06558
0.43	0.065593888	0.06557
0.44	0.065577557	0.06556
0.55	0.065398179	0.06545
0.56	0.065381897	0.06544
0.57	0.065365618	0.06543
0.58	0.065349344	0.06542
0.59	0.065333073	0.06541
0.6	0.065316807	0.0654
0.61	0.065300544	0.06539
0.62	0.065284286	0.06538
0.63	0.065268031	0.06537
0.64	0.065251781	0.06536
0.65	0.065235535	0.06535
0.66	0.065219293	0.06534
0.67	0.065203055	0.06533
0.68	0.065186821	0.06532
0.69	0.06517059	0.06531
0.7	0.065154364	0.0653
0.71	0.065138142	0.06529
0.72	0.065121924	0.06528
0.73	0.065105711	0.06527
0.74	0.065089501	0.06526
0.75	0.065073295	0.06525
0.79	0.065008512	0.06521
0.8	0.064992326	0.0652
0.81	0.064976145	0.06519
0.82	0.064959967	0.06518
0.83	0.064943793	0.06517
0.9	0.064830691	0.0651
0.91	0.06481455	0.06509
0.92	0.064798412	0.06508
0.93	0.064782279	0.06507
0.94	0.06476615	0.06506
0.95	0.064750024	0.06505
0.96	0.064733903	0.06504
0.97	0.064717786	0.06503
0.98	0.064701672	0.06502
1	0.064669458	0.065
1.12	0.064476507	0.06488
1.14	0.064444405	0.06486
1.16	0.064412318	0.06484
1.18	0.064380248	0.06482
1.2	0.064348193	0.0648
1.22	0.064316155	0.06478

Table 10 Predictive and experimental values for arsenic concentration at different distance

Distance [m]	Predictive values Arsenic (As), Conc. [Mg/L] variation of dispersion coefficient and heterogeneous velocity [1.1154/0.0039-0.039]	Experimental values of Arsenic (As), Conc. [Mg/l] variation of dispersion coefficient and heterogeneous velocity [1.154/0.0029-0.0039]
0.1	0.063591512	0.063591512
0.11	0.063575684	0.063581512
0.12	0.063559861	0.063571512
0.13	0.063544042	0.063561512
0.14	0.063528227	0.063551512
0.15	0.063512415	0.063541512
0.16	0.063496608	0.063531512
0.17	0.063480804	0.063521512
0.18	0.063465005	0.063511512
0.19	0.063449209	0.063501512
0.2	0.063433417	0.063491512
0.21	0.063417629	0.063481512
0.22	0.063401846	0.063471512
0.23	0.063386066	0.063461512
0.24	0.06337029	0.063451512
0.25	0.063354518	0.063441512
0.26	0.063338749	0.063431512
0.27	0.063322985	0.063421512
0.28	0.063307225	0.063411512
0.3	0.063275716	0.063391512
0.31	0.063259967	0.063381512
0.32	0.063244223	0.063371512
0.33	0.063228482	0.063361512
0.34	0.063212745	0.063351512
0.35	0.063197012	0.063341512
0.36	0.063181283	0.063331512
0.37	0.063165558	0.063321512
0.38	0.063149837	0.063311512
0.39	0.06313412	0.063301512
0.4	0.063118407	0.063291512
0.41	0.063102697	0.063281512
0.42	0.063086992	0.063271512
0.43	0.06307129	0.063261512
0.44	0.063055593	0.063251512
0.55	0.062883176	0.063141512
0.56	0.062867525	0.063131512
0.57	0.062851878	0.063121512
0.58	0.062836235	0.063111512
0.59	0.062820596	0.063101512
0.6	0.06280496	0.063091512
0.61	0.062789329	0.063081512
0.62	0.062773702	0.063071512
0.63	0.062758078	0.063061512
0.64	0.062742458	0.063051512
0.65	0.062726842	0.063041512
0.66	0.06271123	0.063031512
0.67	0.062695622	0.063021512
0.68	0.062680018	0.063011512
0.69	0.062664418	0.063001512
0.7	0.062648822	0.062991512
0.71	0.062633229	0.062981512
0.72	0.06261764	0.062971512
0.73	0.062602056	0.062961512
0.74	0.062586475	0.062951512
0.75	0.062570898	0.062941512
0.79	0.062508628	0.062901512
0.8	0.062493071	0.062891512
0.81	0.062477517	0.062881512
0.82	0.062461967	0.062871512
0.83	0.062446421	0.062861512
0.9	0.062337707	0.062791512
0.91	0.062322192	0.062781512
0.92	0.062306681	0.062771512
0.93	0.062291174	0.062761512
0.94	0.06227567	0.062751512
0.95	0.06226017	0.062741512
0.96	0.062244675	0.062731512
0.97	0.062229183	0.062721512
0.98	0.062213695	0.062711512
1	0.06218273	0.062691512
1.12	0.061997266	0.062571512
1.14	0.061966409	0.062551512
1.16	0.061935567	0.062531512
1.18	0.061904741	0.062511512
1.2	0.06187393	0.062491512
1.22	0.061843135	0.062471512

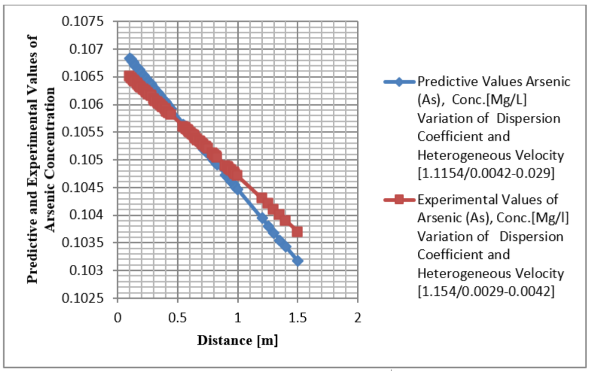

Figure 1 Predictive and experimental values for arsenic concentration at different distance.

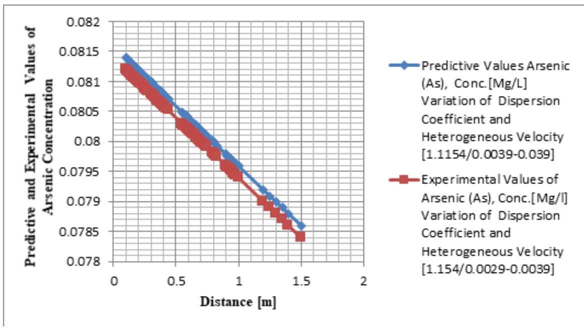

Figure 2 Predictive and experimental values for arsenic concentration at different distance.

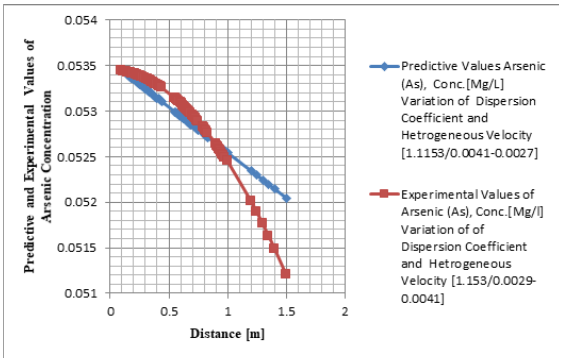

Figure 3 Predictive and experimental values for arsenic concentration at different distance.

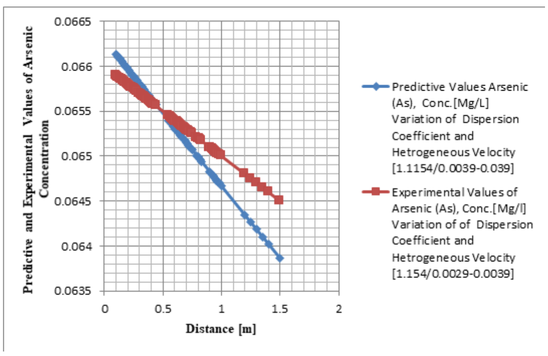

Figure 4 Predictive and experimental values for arsenic concentration at different distance.

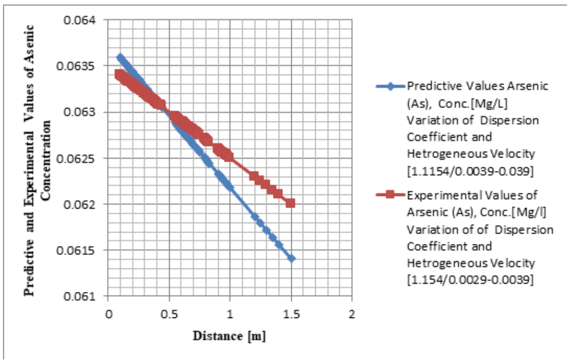

Figure 5 Predictive and experimental values for arsenic concentration at different distance.

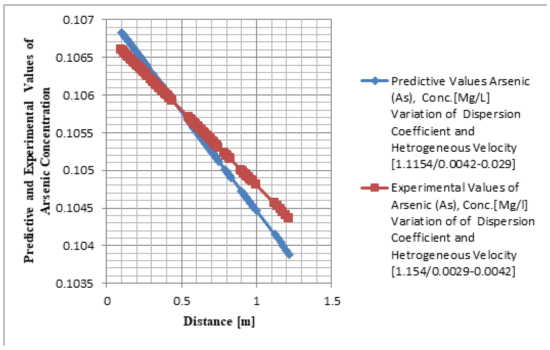

Figure 6 Predictive and experimental values for arsenic concentration at different distance.

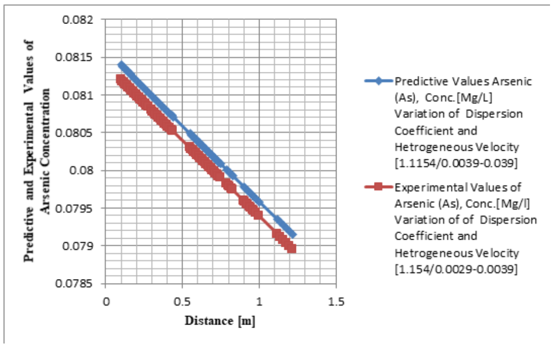

Figure 7 Predictive and experimental values for arsenic concentration at different distance.

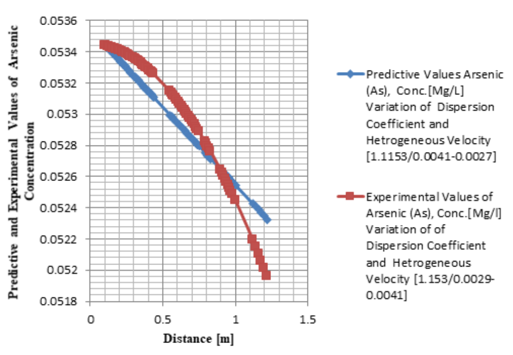

Figure 8 Predictive and experimental values for arsenic concentration at different depth.

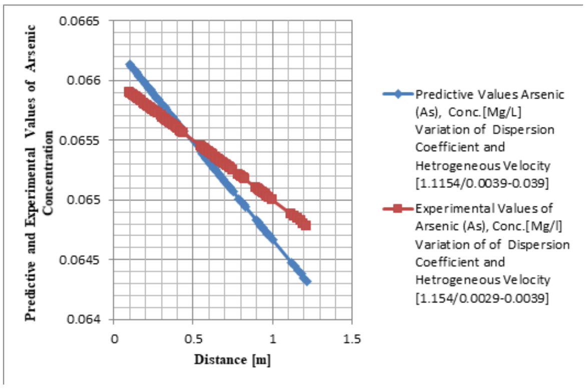

Figure 9 Predictive and experimental values for arsenic concentration at different distance.

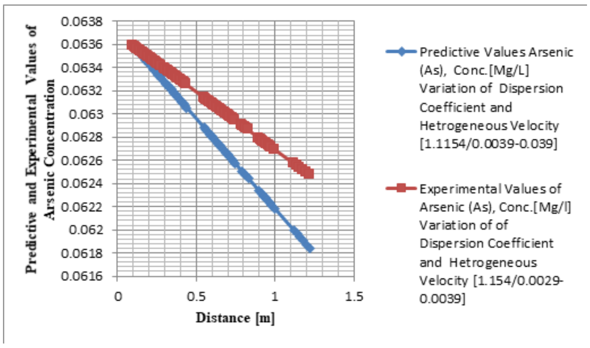

Figure 10 Predictive and experimental values for arsenic concentration at different distance.

Conclusion

The study of arsenic deposition in Choba Creek has been thoroughly assessed in the study location, and the research evaluates two parameters that were observed to influence the system in terms of concentration at different point sources of discharge, and these locations were monitored based on these two observed parameters such as diffusion and dispersion with that creek velocity of flow, and this condition was monitored based on the fact that the charge of this contaminant will definitely increase. The study expressed these significant impacts from these influential parameters to ensure that their rates of transport with respect to rate of concentration are influenced by these parameters. Such conditions were monitored in order to determine their various rates of impact on the transport process of the contaminant. The study suggests that heterogeneous velocity and diffusion are responsible for the creek's observed reduction in arsenic content as a function of distance. Based on the rates of discharge from the industries that have been observed to have an impact on the typical quality of the water in the creek, the study has indicated its levels of significance. Through the use of modeling and simulation, it was possible to monitor the entire process of Arsenic transport, taking into account factors like dispersion, diffusion, and flow velocity. The constructed experimental and predictive model generated the best fits correlation.

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Conflicts of interest

The authors declare that they have no competing interests.

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