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Velocity Influence on Transport Model of Total Petroleum Hydrocarbon in Soil and Ground Water

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ABSTRACT

This study is design to monitor the infiltration rate of Total petroleum hydrocarbon in soil and water environment, the study applied modeling and simulation to developed the transport model that predicts the rate of the contaminant infiltrating from the verdose zone to Phreatic beds. To monitor the pollutant, significant parameters were observed that influence the transport process which were considered, these were based on the investigation carried out which generated the variables impacts on the transport system in soil and water environment. These significant parameters are dispersion and velocity of flow, their rates of dispersion and velocity were observed to developed heterogeneity in their various locations which are graphically represented, depicting exponential growth rates in all the locations. The study monitored the transport process to the optimum depth of 152m. Analytical and numerical simulation were applied in the study, the predictive values from the simulation ranged from 200mg/kg in soil for highly protected area to 1200mg/kg for verdose zone and groundwater deposition (.>5m). The permissible limit compared with the predictive values from figures one to five ranged from 1300mg/kg – 1618mg/kg, while figures 6-10 ranged from 30mg/kg-35mg/kg, this implies that five locations from the figures are above the permissible limit, while five other locations, figures 6-10 are within the permissible limit, the derived simulation data were compared with predictive values, both parameters developed best fits correlation. The study is imperative because the rates of heterogeneity that affect the progressive phase of the TPH in soil and water environment has been determine, their rates of impact on transport process has been evaluated, which is a major breakthrough in predicting and monitoring various rates of TPH contamination in any type of soil and water environments.

Keywords: Velocity Transport, Model, TPH Soil and Ground Water

1. Introduction

Total petroleum hydrocarbon (TPH), often known as hydrocarbons, is a chemical combination mostly composed of hydrogen and carbon. The concentration of Total Petroleum Hydrocarbons (TPH) may be determined in research samples to identify TPH contamination at a specific location. However, it provides little information on the specific impact of the petroleum hydrocarbon sample on humans, animals, and plants (U.S. DHHS, 1999 Ashiru and Ogundare 2018). Petroleum hydrocarbons are widespread contaminants, and their remnants may be found in the environment. These contaminations pose significant risks to human health (Wakeham, 1996; Lipiatou and Saliot, 1991). Macaulay et al. (Macaulay and Rees, 2014) describe the fundamental variance that exists in a route for the dissipation of Total Petroleum Hydrocarbon (TPH). Trace metals naturally exist in aquatic systems due to the presence of crustal minerals resulting from erosion. However, their concentration in water may be elevated by the disposal of high-metal waste and the outflow of home sewage. The deposition of trace metals in water, including biota, serves as evidence for the existence of both natural and anthropogenic sources (Mahipal et al., 2016). Trace metals pose a significant threat to our natural environment owing to their toxicity. Additionally, their persistence in the ecosystem, including bioaccumulation, is a matter of great worry. The accumulation of hazardous trace metal contaminants in sediments has been observed. In most cases, these contaminants do pose a significant ecological risk in the watershed. However, they can be remobilized through bioochemical processes, such as re-suspension, desorption reactions, and redox reactions, when they enter the water column. This can lead to an increase in the dissolved concentration of these contaminants to a toxic level for aquatic organisms (Vukosa *et al*., 2014; Yan *et a*l., 2017, Zuonaki *et. al*., 2024).

The sediment samples were collected in response to the reflections seen in aquatic systems. This material is often known to include petroleum hydrocarbons, trace metals, and other pollutants (Horowit, 1991). Ajao et al. (1996) conducted a study article that provides a comprehensive evaluation of pollution in coastal waterways in Nigeria. The research catalogued a range of water bodies that drain the nation, classifying them according to the geological characteristics of their coastal environments (geomorphic units) (Ibe, 1988). Again, Ajao et al. (1996) conducted a comprehensive analysis of contamination in Nigeria's coastal waterways. The water bodies that drain the nation were identified and classified according to the geological characteristics of their coastal habitats (Ibe, 1988). Wogu and Okaka (2011) analysed surface water samples collected from Warri, Delta State to determine the presence of nine trace elements, including Cr, Cd.

Motivated by the results of the researchers as outlined above, we considered in this article, the velocity influence on the flow model of Total Petroleum Hydrocarbon in soil and water environment

2. Governing Equation

The model equation which captures the scenario we are intestigating is given by

$$Vdy\frac{\partial C}{\partial X} = Vdx\frac{\partial C}{\partial Z} + R\frac{\partial C}{\partial Z} \quad 1$$

Nomenclature

V = Velocity of flow in soil and water

dy = longitudinal Transverse vertical dispersion

dx = longitudinal Transverse Horizontal dispersion

R = Bacterial Transport Coefficient/ specific gravity

XZ = Diffusion in two dimensional flow

C = Initial Concentration

Let C = ZX where Z and X are respectively functions of z alone and x alone. Now from equation (1) we have

$$VdyZX' = VdxZ'X + RZ'X \quad \text{Z} \qquad (2)$$

$$Vdy\frac{X'}{X} = Vdx\frac{Z'}{Z} + R\frac{Z'}{Z} = (Vdx + R)\frac{Z'}{Z} = \beta^2 \qquad (3)$$

$$\Rightarrow Vdy\frac{X'}{X} = \beta^2 \qquad (4)$$

$$(Vdx + R)\frac{Z'}{Z} = \beta^2 \qquad (5)$$

Now from equation (4)

$$Vdy\frac{X^1}{X} = \beta^2 \qquad (6)$$

$$\int\frac{dX}{X} = \frac{\beta^2}{Vdy}\int dx \qquad (7)$$

$$\ln X = \frac{\beta^2}{Vdy}X + K_1 \qquad (8)$$

$$X = A\exp\left(\frac{\beta^2}{Vdy}\right)X \qquad (9)$$

from (5)

$$[Vdy + R]\frac{z^1}{z} = \beta^2 dz \qquad (10)$$

$$\int \frac{dz}{dz} = \frac{\beta^2}{Vdx + R} \int dz \tag{11}$$

$$\ln z = \frac{\beta^2}{Vdy + R} Z + K_2 \tag{12}$$

$$Z = B \exp\left(\frac{\beta^2}{Vdx + R} \right) Z \tag{13}$$

Recall C = ZX = XZ

$$C(Z, X) = AB \exp\left(\frac{\beta^2}{Vdy} \right) X \exp\left(\frac{\beta^2}{Vdx + R} \right) Z \tag{14}$$

$$C(X, Z) = AB \exp\left(\frac{X}{Vdy} + \frac{Z}{Vdx + R} \right) \beta^2 \tag{15}$$

3. Material and Method

Standard laboratory experiment were performed to monitor [TPH] using the standard method for the experiment at different samples in different stations, the water sample were collected in sequences base on specification stipulated at different locations, this samples collected at different location generated variations at different distance producing different [THP] concentration through physiochemical analysis, the experimental result were compared with the theoretical values for model validation.

4. Results and Discussion

Table 1: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

Depth [m]	**Predictive Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**
2	65.1509286	141.36
4	67.91429596	133.384
6	70.79487115	126.072
8	73.79762553	119.424
10	76.92774131	113.44
12	80.19062051	108.12
14	83.59189426	103.464
16	87.13743255	99.472
18	90.83335434	96.144
20	94.68603813	93.48
22	98.70213296	91.48
24	102.8885699	90.144

26	107.2525739	89.472
28	111.8016766	89.464
30	116.5437288	90.12
32	121.4869144	91.44
34	126.6397646	93.424
38	137.6104073	99.384
40	143.4471331	103.36
42	149.5314228	108
44	155.8737768	113.304
46	162.4851409	119.272
48	169.376925	125.904
50	176.5610231	133.2
54	191.8562813	149.784
56	199.9938381	159.072
58	208.4765483	169.024
60	217.3190514	179.64
62	226.536608	190.92
64	236.145126	202.864
66	246.1611879	215.472
68	256.6020796	228.744
70	267.4858203	242.68
72	278.8311933	257.28
74	290.6577787	272.544
76	302.9859869	288.472
78	315.8370944	305.064
80	329.2332798	322.32
82	343.1976625	340.24
84	357.7543425	358.824
86	372.928442	378.072
88	388.7461488	397.984
90	405.2347613	418.56
92	422.422736	439.8
94	440.3397362	461.704
96	459.0166834	484.272
98	478.4858107	507.504
100	498.7807182	531.4
102	519.9364314	555.96

104	541.9894611	581.184
106	564.9778669	607.072
108	588.9413227	633.624
110	613.921185	660.84
112	639.9605647	688.72
114	667.1044009	717.264
116	695.3995391	746.472
118	724.8948115	776.344
120	755.6411217	806.88
122	787.6915323	838.08
124	821.1013565	869.944
126	855.9282536	902.472
128	892.2323286	935.664
130	930.0762358	969.52
132	969.5252869	1004.04
134	1010.647564	1039.224
136	1053.514036	1075.072
138	1098.198684	1111.584
140	1144.778625	1148.76
142	1193.334247	1186.6
144	1243.94935	1225.104
146	1296.711284	1264.272
148	1351.711109	1304.104
150	1409.043743	1344.6
152	1468.808133	1385.76
154	1531.10742	1427.584
152	1468.808133	1385.76

Table 2: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

Depth [m]	**Predictive Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**
2	65.18164613	145.582
4	67.97835187	137.052
6	70.89505401	129.21
8	73.93690116	122.056
10	77.10926284	115.59

12	80.41773893	109.812
14	83.86816962	104.722
16	87.46664565	100.32
18	91.21951912	96.606
20	95.13341464	93.58
22	99.21524108	91.242
24	103.4722038	89.592
26	107.9118171	88.63
28	112.541918	88.356
30	117.3706796	88.77
32	122.4066256	89.872
34	127.6586457	91.662
38	138.8483894	97.306
40	144.8058653	101.16
42	151.0189547	105.702
44	157.498625	110.932
46	164.2563143	116.85
48	171.3039512	123.456
50	178.6539764	130.75
54	194.313646	147.402
56	202.6509329	156.76
58	211.3459424	166.806
60	220.4140228	177.54
62	229.8711814	188.962
64	239.734112	201.072
66	250.0202248	213.87
68	260.7476771	227.356
70	271.9354051	241.53
72	283.6031575	256.392
74	295.7715304	271.942
76	308.4620037	288.18
78	321.6969787	305.106
80	335.499818	322.72
82	349.8948866	341.022
84	364.9075949	360.012
86	380.5644435	379.69
88	396.8930701	400.056

90	413.9222983	421.11
92	431.6821884	442.852
94	450.2040903	465.282
96	469.5206991	488.4
98	489.666113	512.206
100	510.6758927	536.7
102	532.5871252	561.882
104	555.4384884	587.752
106	579.27032	614.31
108	604.1246881	641.556
110	630.0454662	669.49
112	657.0784099	698.112
114	685.2712383	727.422
116	714.6737177	757.42
118	745.3377498	788.106
120	777.3174632	819.48
122	810.669309	851.542
124	845.4521604	884.292
126	881.7274166	917.73
128	919.5591112	951.856
130	959.0140252	986.67
132	1000.161805	1022.172
134	1043.075086	1058.362
136	1087.829618	1095.24
138	1134.504403	1132.806
140	1183.181833	1171.06
142	1233.947832	1210.002
144	1286.892015	1249.632
146	1342.107839	1289.95
148	1399.692771	1330.956
150	1459.748462	1372.65
152	1522.380923	1415.032
154	1587.700714	1458.102
152	1522.380923	1415.032

Table 3: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

Depth[m]	**Predictive Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**
2	65.23443358	151.33
4	68.0885012	141.804
6	71.06743695	133.022
8	74.17670393	124.984
10	77.42200426	117.69
12	80.80928952	111.14
14	84.34477168	105.334
16	88.0349345	100.272
18	91.8865454	95.954
20	95.90666789	92.38
22	100.1026745	89.55
24	104.4822604	87.464
26	109.0534572	86.122
28	113.8246482	85.524
30	118.8045832	85.67
32	124.0023951	86.56
34	129.4276161	88.194
38	141.0005183	93.694
40	147.1694231	97.56
42	153.6082234	102.17
44	160.3287271	107.524
46	167.3432592	113.622
48	174.6646837	120.464
50	182.3064273	128.05
54	198.6075423	145.454
56	207.2968084	155.272
58	216.3662381	165.834
60	225.8324638	177.14
62	235.7128458	189.19
64	246.0255038	201.984
66	256.7893502	215.522
68	268.0241249	229.804
70	279.7504316	244.83
72	291.9897752	260.6

74	304.7646016	277.114
76	318.0983386	294.372
78	332.0154391	312.374
80	346.5414257	331.12
82	361.7029379	350.61
84	377.5277805	370.844
86	394.0449748	391.822
88	411.2848118	413.544
90	429.2789078	436.01
92	448.0602624	459.22
94	467.6633189	483.174
96	488.1240274	507.872
98	509.4799112	533.314
100	531.7701349	559.5
102	555.0355767	586.43
104	579.3189035	614.104
106	604.6646485	642.522
108	631.1192937	671.684
110	658.7313543	701.59
112	687.5514685	732.24
114	717.6324898	763.634
116	749.0295839	795.772
118	781.8003303	828.654
120	816.0048275	862.28
122	851.7058036	896.65
124	888.9687309	931.764
126	927.8619461	967.622
128	968.456776	1004.224
130	1010.827668	1041.57
132	1055.052326	1079.66
134	1101.211854	1118.494
136	1149.390905	1158.072
138	1199.677834	1198.394
140	1252.164864	1239.46
142	1306.94825	1281.27
144	1364.128461	1323.824
146	1423.81036	1367.122

148	1486.103398	1411.164
150	1551.121815	1455.95
152	1618.984848	1501.48
154	1689.816953	1547.754
152	1618.984848	1501.48

Table 4: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

Depth[m]	**Predictive Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**
2	65.2030702	151.33
4	68.02304581	141.804
6	70.9649829	133.022
8	74.03415618	124.984
10	77.23606852	117.69
12	80.57646076	111.14
14	84.06132204	105.334
16	87.69690051	100.272
18	91.48971456	95.954
20	95.44656449	92.38
22	99.57454471	89.55
24	103.8810565	87.464
26	108.3738211	86.122
28	113.0608938	85.524
30	117.9506783	85.67
32	123.0519417	86.56
34	128.3738303	88.194
38	139.718063	93.694
40	145.7607468	97.56
42	152.0647713	102.17
44	158.6414393	107.524
46	165.5025424	113.622
48	172.6603823	120.464
50	180.1277924	128.05
54	196.0454572	145.454
56	204.5242513	155.272
58	213.3697458	165.834

60	222.5978003	177.14
62	232.2249599	189.19
64	242.2684858	201.984
66	252.7463854	215.522
68	263.677445	229.804
70	275.0812633	244.83
72	286.9782867	260.6
74	299.3898459	277.114
76	312.3381943	294.372
78	325.8465473	312.374
80	339.9391248	331.12
82	354.6411938	350.61
84	369.9791145	370.844
86	385.9803868	391.822
88	402.6737001	413.544
90	420.0889845	436.01
92	438.2574647	459.22
94	457.2117158	483.174
96	476.9857216	507.872
98	497.6149358	533.314
100	519.1363455	559.5
102	541.5885372	586.43
104	565.0117666	614.104
106	589.4480301	642.522
108	614.9411405	671.684
110	641.5368056	701.59
112	669.28271	732.24
114	698.2286003	763.634
116	728.426375	795.772
118	759.930177	828.654
120	792.7964909	862.28
122	827.0842439	896.65
124	862.8549123	931.764
126	900.1726306	967.622
128	939.1043076	1004.224
130	979.7197455	1041.57
132	1022.091765	1079.66

134	1066.296338	1118.494
136	1112.41272	1158.072
138	1160.523594	1198.394
140	1210.715222	1239.46
142	1263.077594	1281.27
144	1317.704592	1323.824
146	1374.694161	1367.122
148	1434.148478	1411.164
150	1496.174142	1455.95
152	1560.882362	1501.48
154	1628.389155	1547.754
152	1560.882362	1501.48

Table 5: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

Depth[m]	**Predictive Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Soil on Variation of Velocity of Flow [Mg/L**
2	65.04677046	128.412
4	67.69731756	122.092
6	70.45587003	116.34
8	73.32682889	111.156
10	76.31477452	106.54
12	79.42447394	102.492
14	82.66088841	99.012
16	86.02918135	96.1
18	89.5347266	93.756
20	93.18311696	91.98
22	96.98017312	90.772
24	100.931953	90.132
26	105.0447612	90.06
28	109.3251596	90.556
30	113.779977	91.62
32	118.4163207	93.252
34	123.2415877	95.452
38	133.4899984	101.556
40	138.9294926	105.46
42	144.590637	109.932
44	150.4824636	114.972

46	156.6143723	120.58
48	162.9961461	126.756
50	169.6379664	133.5
54	183.7445645	148.692
56	191.2318482	157.14
58	199.0242261	166.156
60	207.1341305	175.74
62	215.5744998	185.892
64	224.3588001	196.612
66	233.501046	207.9
68	243.0158231	219.756
70	252.9183114	232.18
72	263.2243096	245.172
74	273.9502599	258.732
76	285.1132748	272.86
78	296.7311639	287.556
80	308.8224625	302.82
82	321.4064613	318.652
84	334.503237	335.052
86	348.1336845	352.02
88	362.3195498	369.556
90	377.0834655	387.66
92	392.448986	406.332
94	408.4406258	425.572
96	425.0838981	445.38
98	442.405356	465.756
100	460.4326343	486.7
102	479.194494	508.212
104	498.7208681	530.292
106	519.0429094	552.94
108	540.1930398	576.156
110	562.2050026	599.94
112	585.1139162	624.292
114	608.9563296	649.212
116	633.7702815	674.7
118	659.5953604	700.756
120	686.4727681	727.38

122	714.4453853	754.572
124	743.5578397	782.332
126	773.856578	810.66
128	805.3899393	839.556
130	838.2082322	869.02
132	872.3638157	899.052
134	907.9111821	929.652
136	944.9070442	960.82
138	983.4104258	992.556
140	1023.482756	1024.86
142	1065.187966	1057.732
144	1108.592594	1091.172
146	1153.765888	1125.18
148	1200.779918	1159.756
150	1249.709692	1194.9
152	1300.633271	1230.612
154	1353.631902	1266.892
152	1300.633271	1230.612

Table 6: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

Depth[m]	**Predictive Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L**
2	0.701927534	1.024
4	0.739053395	0.738
6	0.77814289	0.472
8	0.81929988	0.226
10	0.862633717	0
12	0.908259536	-0.206
14	0.956298565	-0.392
16	1.00687844	-0.558
18	1.060133551	-0.704
20	1.116205394	-0.83
22	1.17524295	-0.936
24	1.237403078	-1.022
26	1.302850937	-1.088
28	1.371760418	-1.134
30	1.444314612	-1.16

32	1.520706291	-1.166
34	1.601138425	-1.152
38	1.774990182	-1.064
40	1.868871723	-0.99
42	1.96771878	-0.896
44	2.071793986	-0.782
46	2.181373866	-0.648
48	2.296749568	-0.494
50	2.418227641	-0.32
54	2.68079902	0.088
56	2.822589968	0.322
58	2.971880424	0.576
60	3.129067046	0.85
62	3.294567474	1.144
64	3.468821434	1.458
66	3.652291913	1.792
68	3.845466384	2.146
70	4.048858105	2.52
72	4.263007478	2.914
74	4.48848349	3.328
76	4.725885222	3.762
78	4.97584344	4.216
80	5.239022273	4.69
82	5.516120978	5.184
84	5.807875794	5.698
86	6.115061901	6.232
88	6.438495481	6.786
90	6.779035884	7.36
92	7.137587912	7.954
94	7.515104224	8.568
96	7.912587864	9.202
98	8.331094931	9.856
100	8.771737382	10.53
102	9.235685985	11.224
104	9.724173433	11.938
106	10.23849762	12.672
108	10.78002508	13.426

110	11.35019463	14.2
112	11.95052119	14.994
114	12.58259981	15.808
116	13.24810988	16.642
118	13.94881965	17.496
120	14.68659087	18.37
122	15.46338377	19.264
124	16.28126226	20.178
126	17.1423994	21.112
128	18.04908321	22.066
130	19.00372271	23.04
132	20.00885433	24.034
134	21.06714867	25.048
136	22.18141757	26.082
138	23.3546216	27.136
140	24.58987793	28.21
142	25.89046856	29.304
144	27.25984913	30.418
146	28.70165802	31.552
148	30.21972606	32.706
150	31.81808669	33.88
152	33.50098669	35.074
154	35.27289747	36.288
152	33.50098669	35.074

Table 7: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

Depth[m]	**Predictive Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L**
2	0.658320339	3.1504
4	0.693417069	2.8676
6	0.730384896	2.6016
8	0.769323571	2.3524
10	0.810338166	2.12
12	0.853539354	1.9044
14	0.899043706	1.7056
16	0.946974011	1.5236
18	0.997459603	1.3584

20	1.05063671	1.21
22	1.106648823	1.0784
24	1.165647085	0.9636
26	1.227790694	0.8656
28	1.293247337	0.7844
30	1.36219364	0.72
32	1.434815645	0.6724
34	1.511309314	0.6416
38	1.676748281	0.6304
40	1.766139994	0.65
42	1.860297406	0.6864
44	1.95947459	0.7396
46	2.063939161	0.8096
48	2.173973004	0.8964
50	2.28987303	1
54	2.540539273	1.2576
56	2.675981879	1.4116
58	2.818645275	1.5824
60	2.96891442	1.77
62	3.127194794	1.9744
64	3.293913497	2.1956
66	3.469520399	2.4336
68	3.65448935	2.6884
70	3.849319467	2.96
72	4.054536472	3.2484
74	4.270694117	3.5536
76	4.498375676	3.8756
78	4.738195518	4.2144
80	4.990800765	4.57
82	5.256873039	4.9424
84	5.537130303	5.3316
86	5.832328794	5.7376
88	6.143265067	6.1604
90	6.470778143	6.6
92	6.815751774	7.0564
94	7.179116826	7.5296
96	7.561853792	8.0196

98	7.964995439	8.5264
100	8.389629592	9.05
102	8.836902071	9.5904
104	9.308019782	10.1476
106	9.804253977	10.7216
108	10.32694368	11.3124
110	10.87749929	11.92
112	11.45740643	12.5444
114	12.06822989	13.1856
116	12.7116179	13.8436
118	13.38930656	14.5184
120	14.10312453	15.21
122	14.85499795	15.9184
124	15.64695565	16.6436
126	16.48113463	17.3856
128	17.35978581	18.1444
130	18.28528011	18.92
132	19.26011487	19.7124
134	20.28692055	20.5216
136	21.36846786	21.3476
138	22.50767519	22.1904
140	23.70761657	23.05
142	24.97152987	23.9264
144	26.3028256	24.8196
146	27.70509609	25.7296
148	29.18212519	26.6564
150	30.73789846	27.6
152	32.37661396	28.5604
154	34.10269354	29.5376
152	32.37661396	28.5604

Table 8: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

Depth[m]	**Predictive Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L**	**Experimental Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L**
2	0.739991284	2.7874
4	0.777573682	2.5446
6	0.817064801	2.3186

8	0.85856158	2.1094
10	0.902165882	1.917
12	0.947984742	1.7414
14	0.996130634	1.5826
16	1.046721741	1.4406
18	1.09988225	1.3154
20	1.155742655	1.207
22	1.214440077	1.1154
24	1.276118601	1.0406
26	1.340929632	0.9826
28	1.40903226	0.9414
30	1.480593659	0.917
32	1.555789492	0.9094
34	1.634804342	0.9186
38	1.80507678	0.9874
40	1.896752339	1.047
42	1.993083881	1.1234
44	2.094307874	1.2166
46	2.200672793	1.3266
48	2.312439732	1.4534
50	2.429883049	1.597
54	2.682966615	1.9346
56	2.819228112	2.1286
58	2.962410006	2.3394
60	3.112863769	2.567
62	3.27095872	2.8114
64	3.437082938	3.0726
66	3.61164421	3.3506
68	3.795071034	3.6454
70	3.98781367	3.957
72	4.190345247	4.2854
74	4.403162921	4.6306
76	4.626789099	4.9926
78	4.861772719	5.3714
80	5.108690598	5.767
82	5.36814885	6.1794
84	5.640784369	6.6086

86	5.927266398	7.0546
88	6.228298169	7.5174
90	6.544618628	7.997
92	6.87700425	8.4934
94	7.226270949	9.0066
96	7.593276072	9.5366
98	7.978920514	10.0834
100	8.38415092	10.647
102	8.809962015	11.2274
104	9.257399044	11.8246
106	9.727560335	12.4386
108	10.2216	13.0694
110	10.74073077	13.717
112	11.28622695	14.3814
114	11.85942759	15.0626
116	12.46173972	15.7606
118	13.09464186	16.4754
120	13.75968759	17.207
122	14.45850942	17.9554
124	15.19282274	18.7206
126	15.9644301	19.5026
128	16.77522555	20.3014
130	17.62719938	21.117
132	18.52244293	21.9494
134	19.46315378	22.7986
136	20.45164109	23.6646
138	21.49033133	24.5474
140	22.58177417	25.447
142	23.7286488	26.3634
144	24.93377047	27.2966
146	26.2000974	28.2466
148	27.53073807	29.2134
150	28.92895881	30.197
152	30.39819186	31.1974
154	31.94204377	32.2146
152	30.39819186	31.1974

Table 9: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

Depth[m]	Predictive Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L	Experimental Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L
2	0.740763612	3.0208
4	0.779197634	2.7472
6	0.819625781	2.4912
8	0.862151514	2.2528
10	0.906883667	2.032
12	0.953936717	1.8288
14	1.003431083	1.6432
16	1.055493431	1.4752
18	1.110256999	1.3248
20	1.167861938	1.192
22	1.228455671	1.0768
24	1.292193269	0.9792
26	1.359237849	0.8992
28	1.429760992	0.8368
30	1.503943182	0.792
32	1.581974264	0.7648
34	1.664053937	0.7552
38	1.841210185	0.7888
40	1.93674014	0.832
42	2.037226602	0.8928
44	2.142926736	0.9712
46	2.254111051	1.0672
48	2.37106409	1.1808
50	2.494085159	1.312
54	2.759607063	1.6272
56	2.902787423	1.8112
58	3.0533966	2.0128
60	3.211820033	2.232
62	3.378463159	2.4688
64	3.553752452	2.7232
66	3.738136512	2.9952
68	3.932087216	3.2848
70	4.136100921	3.592
72	4.350699741	3.9168

74	4.576432876	4.2592
76	4.813878024	4.6192
78	5.063642854	4.9968
80	5.326366564	5.392
82	5.602721517	5.8048
84	5.893414962	6.2352
86	6.199190841	6.6832
88	6.520831696	7.1488
90	6.859160671	7.632
92	7.215043618	8.1328
94	7.589391312	8.6512
96	7.983161786	9.1872
98	8.397362776	9.7408
100	8.833054306	10.312
102	9.291351399	10.9008
104	9.773426929	11.5072
106	10.28051462	12.1312
108	10.81391222	12.7728
110	11.3749848	13.432
112	11.96516825	14.1088
114	12.58597297	14.8032
116	13.23898773	15.5152
118	13.92588372	16.2448
120	14.64841885	16.992
122	15.40844223	17.7568
124	16.20789891	18.5392
126	17.04883486	19.3392
128	17.93340222	20.1568
130	18.86386475	20.992
132	19.84260371	21.8448
134	20.87212388	22.7152
136	21.95506002	23.6032
138	23.09418357	24.5088
140	24.29240978	25.432
142	25.55280515	26.3728
144	26.8785953	27.3312
146	28.27317317	28.3072

148	29.74010778	29.3008
150	31.2831533	30.312
152	32.90625871	31.3408
154	34.61357786	32.3872
152	32.90625871	31.3408

Table 10: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

Depth[m]	Predictive Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L	Experimental Values of [TPH] Concentration in Ground Water on Variation of Velocity of Flow [Mg/L
2	0.74109799	3.1282
4	0.779901248	2.8398
6	0.820736211	2.5698
8	0.863709258	2.3182
10	0.908932337	2.085
12	0.956523258	1.8702
14	1.006605999	1.6738
16	1.059311029	1.4958
18	1.11477565	1.3362
20	1.173144351	1.195
22	1.234569187	1.0722
24	1.299210175	0.9678
26	1.36723571	0.8818
28	1.438823004	0.8142
30	1.514158548	0.765
32	1.593438596	0.7342
34	1.67686968	0.7218
38	1.857065713	0.7522
40	1.954300088	0.795
42	2.056625571	0.8562
44	2.16430873	0.9358
46	2.277630086	1.0338
48	2.396884852	1.1502
50	2.522383696	1.285
54	2.793438472	1.6098
56	2.939700525	1.7998
58	3.093620733	2.0082
60	3.255600073	2.235
62	3.426060512	2.4802
64	3.605446114	2.7438
66	3.794224193	3.0258
68	3.992886531	3.3262
70	4.20195066	3.645

72	4.421961207	3.9822
74	4.653491319	4.3378
76	4.89714415	4.7118
78	5.153554435	5.1042
80	5.423390143	5.515
82	5.707354219	5.9442
84	6.006186411	6.3918
86	6.320665202	6.8578
88	6.651609833	7.3422
90	6.999882443	7.845
92	7.366390309	8.3662
94	7.752088214	8.9058
96	8.157980931	9.4638
98	8.585125845	10.0402
100	9.034635702	10.635
102	9.50768151	11.2482
104	10.00549559	11.8798
106	10.5293748	12.5298
108	11.08068387	13.1982
110	11.66085901	13.885
112	12.27141163	14.5902
114	12.91393226	15.3138
116	13.59009472	16.0558
118	14.30166048	16.8162
120	15.0504832	17.595
122	15.83851365	18.3922
124	16.6678047	19.2078
126	17.54051671	20.0418
128	18.45892319	20.8942
130	19.42541664	21.765
132	20.44251486	22.6542
134	21.51286748	23.5618
136	22.63926285	24.4878
138	23.82463531	25.4322
140	25.07207287	26.395
142	26.38482519	27.3762
144	27.7663121	28.3758

146	29.22013249	29.3938
148	30.75007367	30.4302
150	32.36012126	31.485
152	34.05446957	32.5582
154	35.83753251	33.6498
152	34.05446957	32.5582

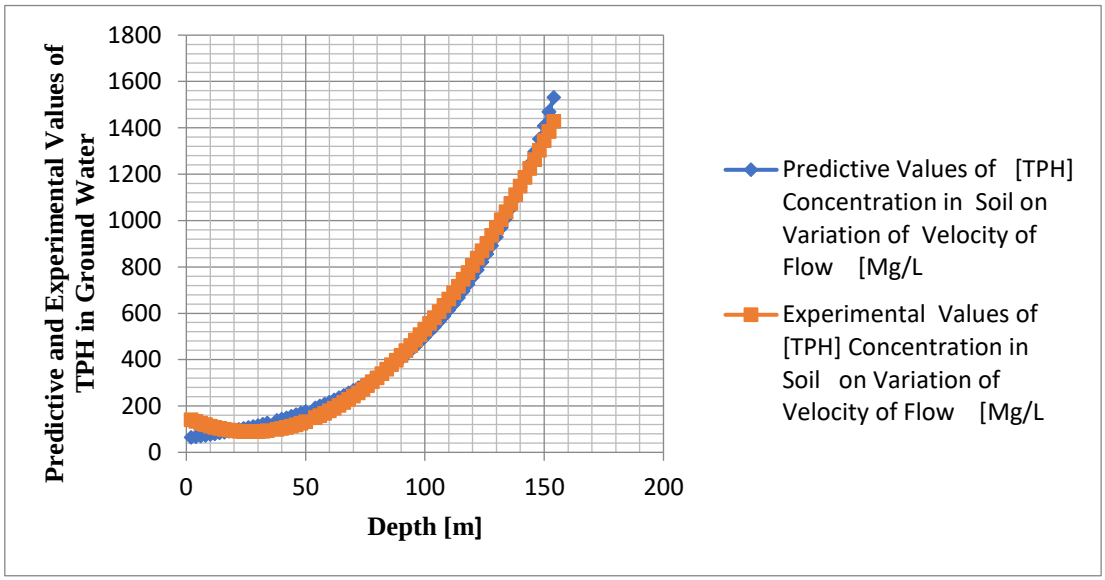

Figure 1: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

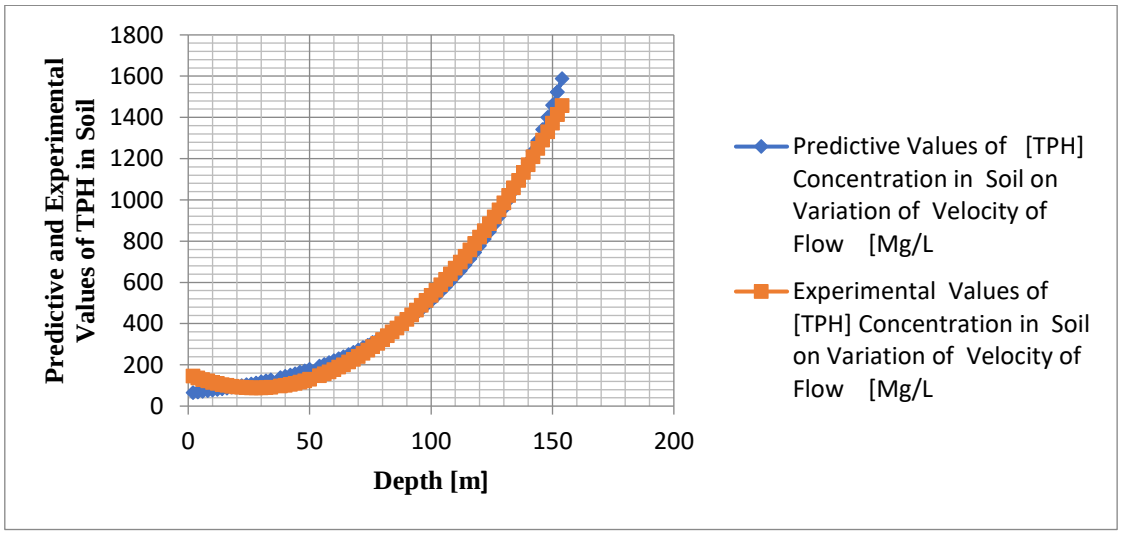

Figure 2: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

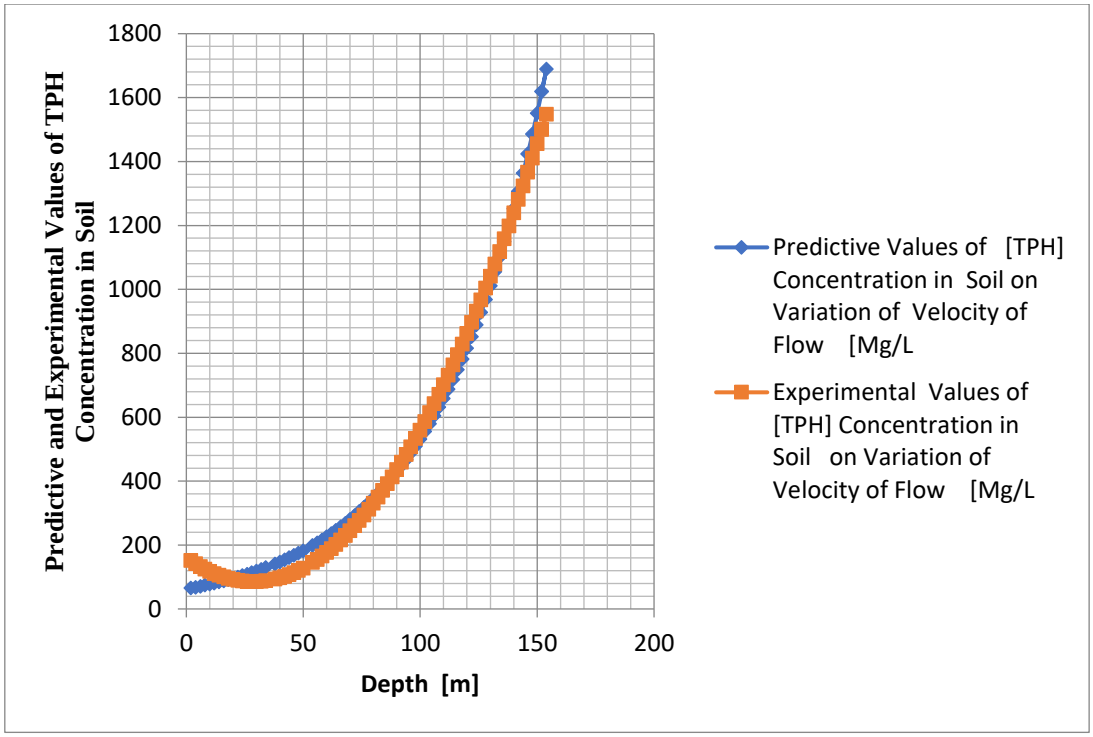

Figure 3: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

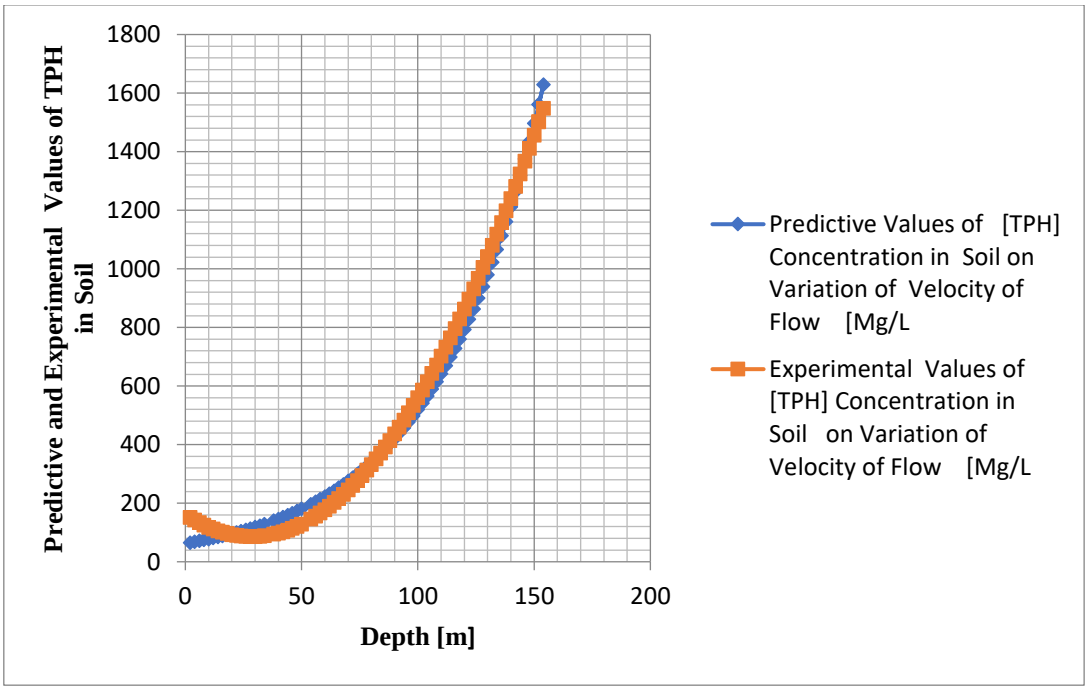

Figure 4: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

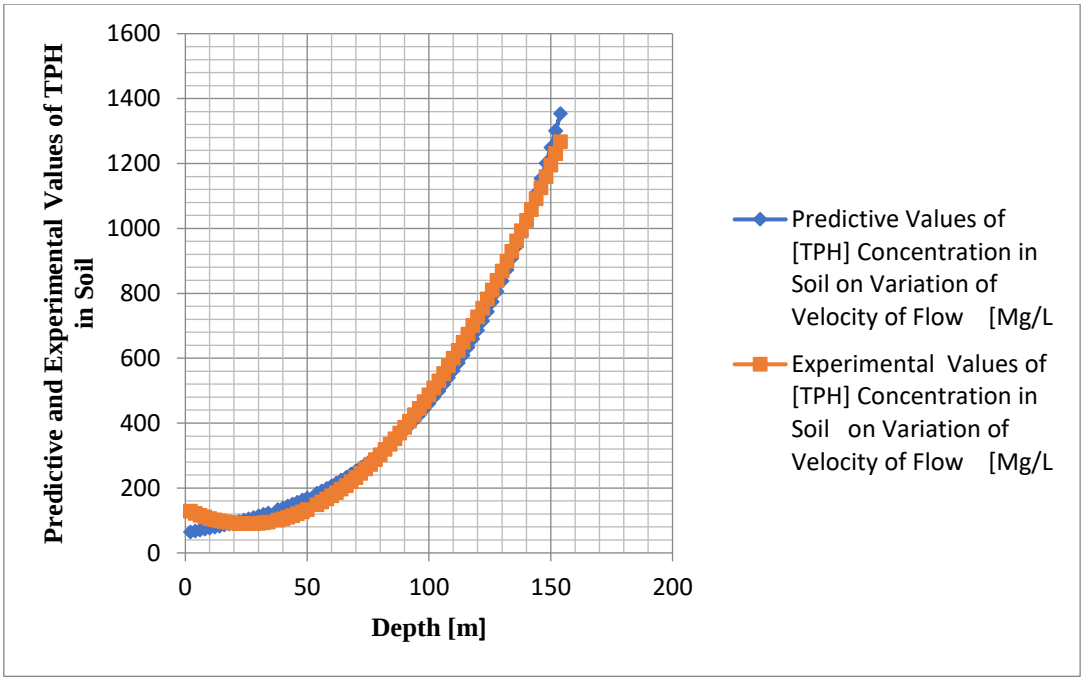

Figure 5: Predictive and Experimental Values of [TPH] Concentration in Soil at Different Distance

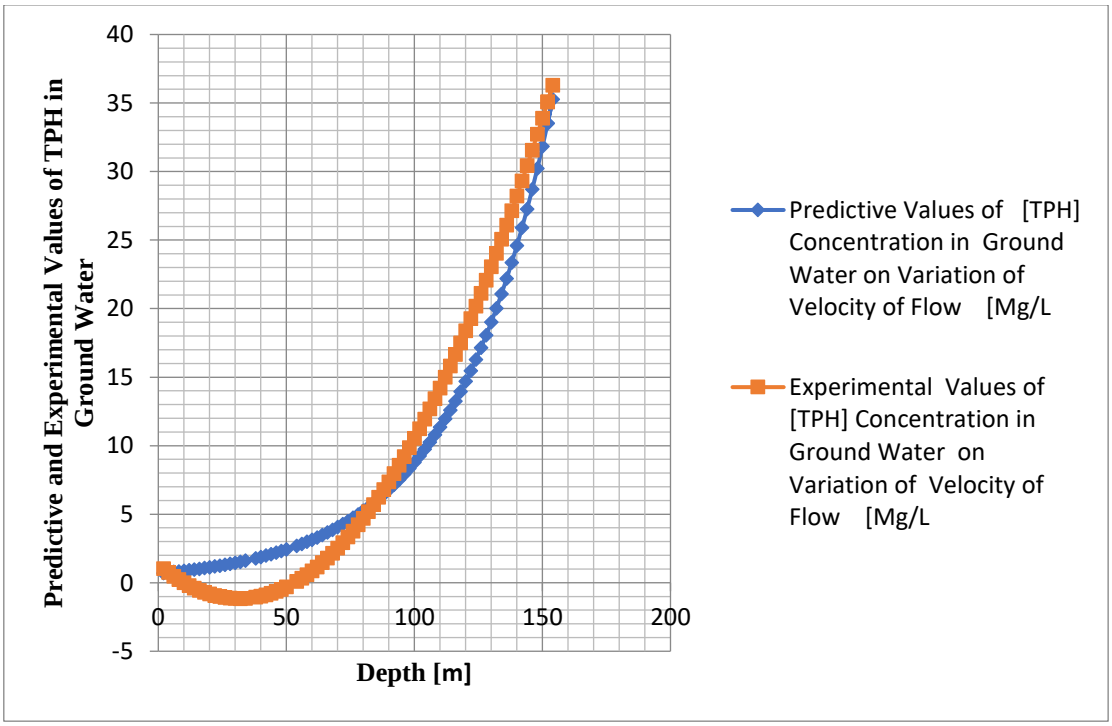

Figure 6: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

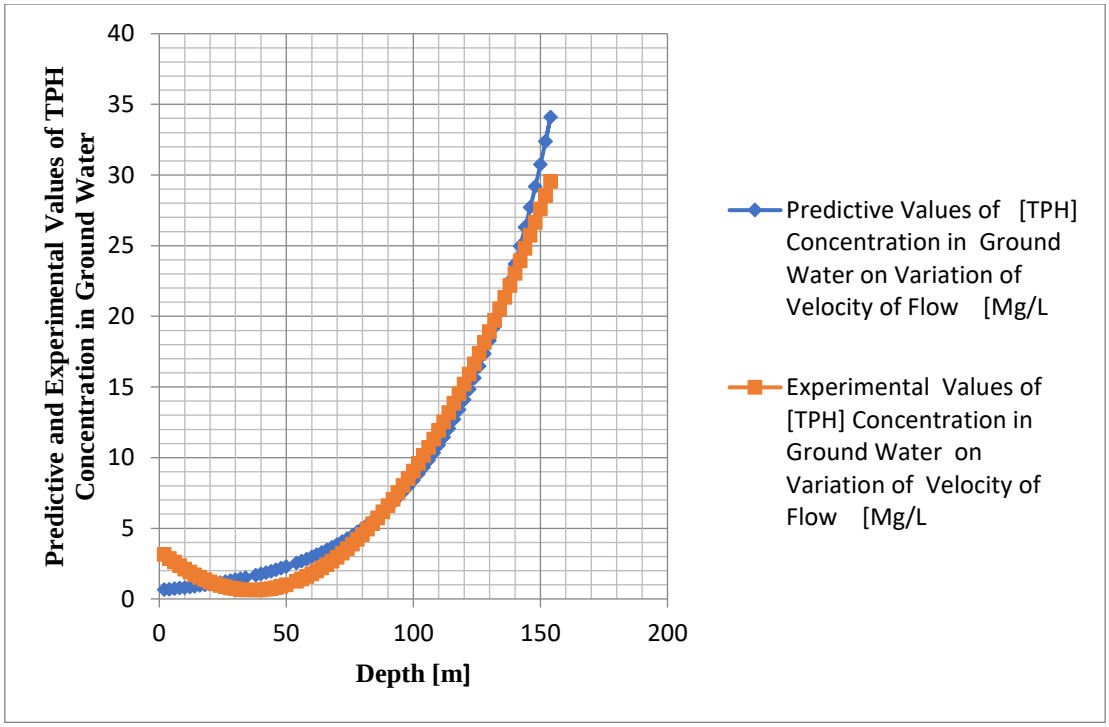

Figure 7: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

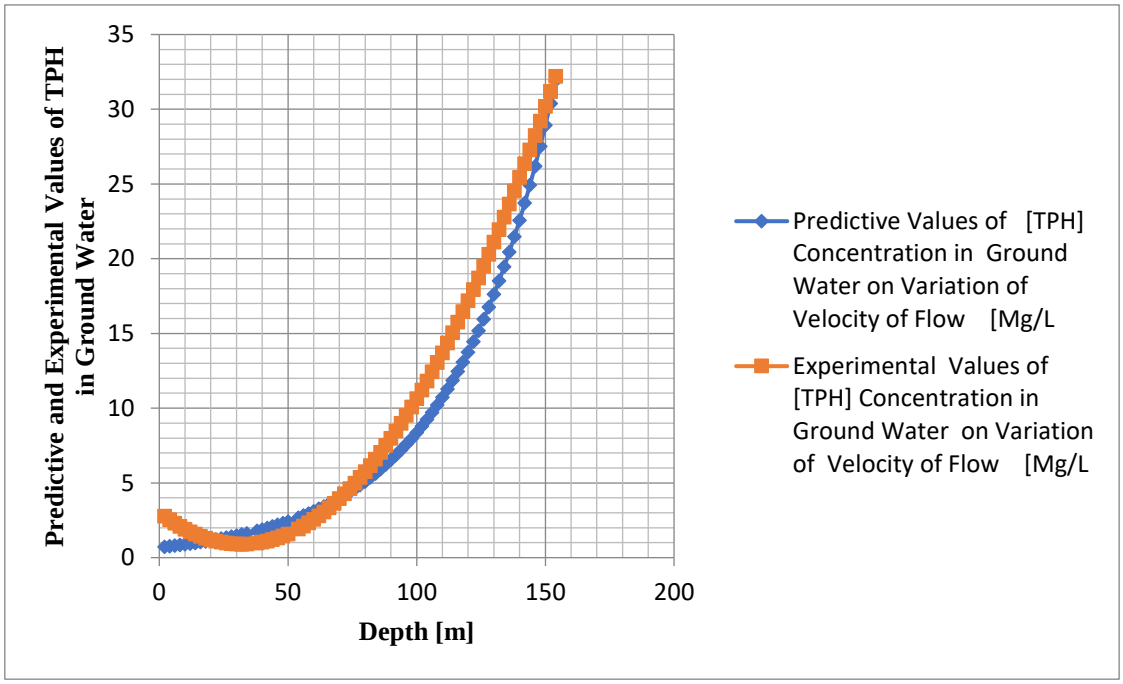

Figure 8: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

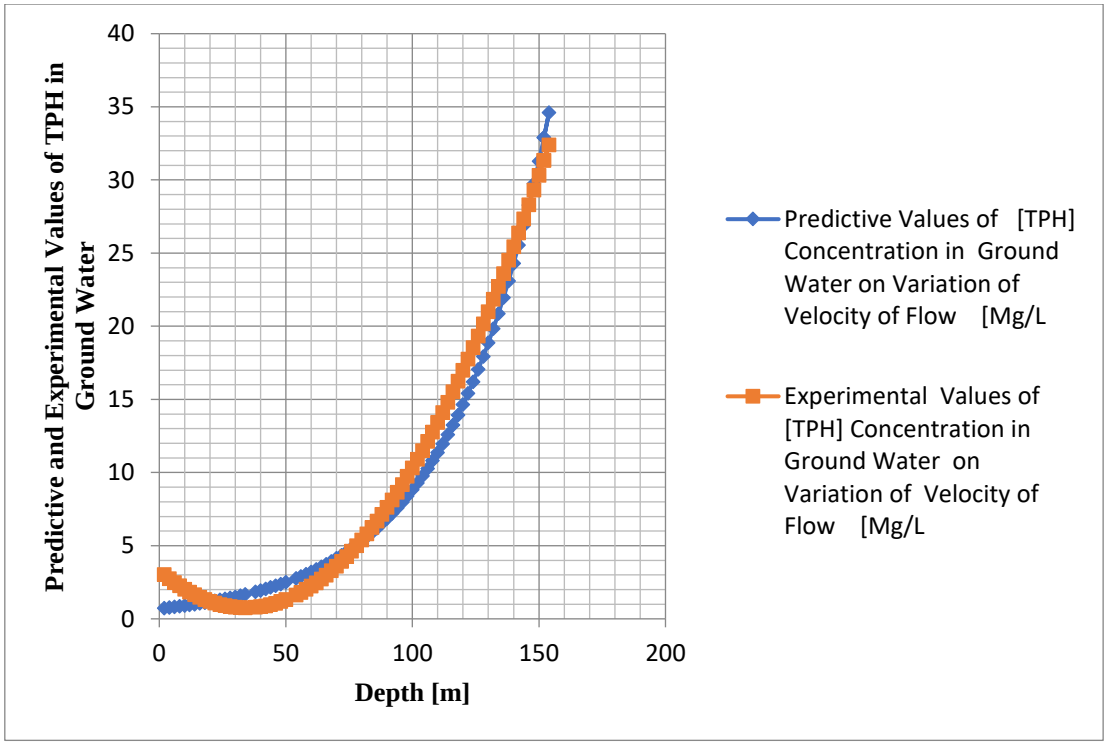

Figure 9: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

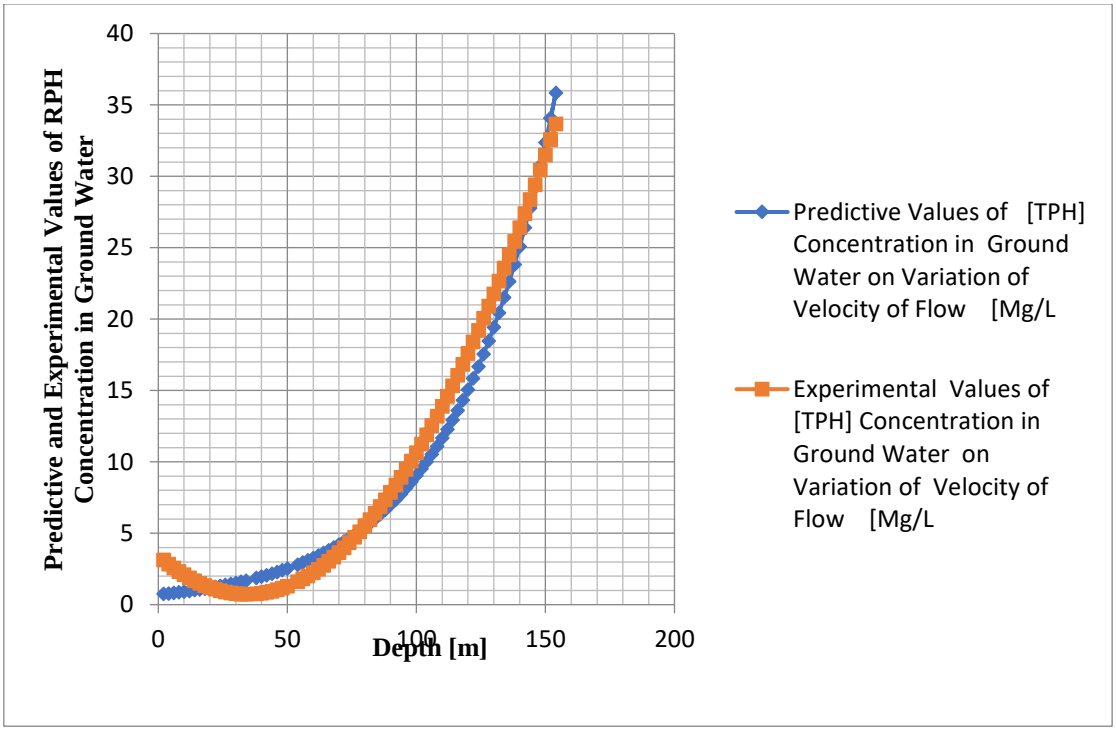

Figure 10: Predictive and Experimental Values of [TPH] Concentration in Ground Water at Different Distance

Figure one to ten evaluate the infiltration rates of TPH concentration in soil and ground water environment, the study monitored the fluid passage within the soil percolation in different verdose zone, thus recharge in groundwater which is within the Aquitard and Phreatic beds. The same process the contaminant TPH infiltrates within the intercedes of different verdose zone to Phreatic depositions, but the transport of TPH contaminant within the soil and ground water Aquiferous zone is a subject of concern, the study investigated some influential parameters in soil that influence total petroleum hydrocarbon in soil and ground water aquifers, the study monitor the system applying the formation characteristics variable that is observed as highly significant parameters in soil and water environment, these parameters that were influential are soil porosity and permeability, these influence the exponential growth rate as observed in all the figures for TPH transport in soil and ground water environment. Such conditions were evaluated for transport process of the contaminant in the study of TPH in soil and water depositions. The exponential process of transport implies that the porosity at homogeneous deposition reflected the infiltration of the contaminant with the verdose zone of the formations, while that of its permeation were also

monitored in verdose zone to ground water depositions, such permeability's in the soil to Phreatic beds were observed to pressure flow dynamics of the soil that is affected by the infiltration of TPH in all the verdose zone to Phreatic beds, the pressures from the significant parameters expressed it influences as the growth of the contaminant are generating highest concentration at the optimum depth of 152m, since the total petroleum hydrocarbon are used to describe a large family of several hundreds of chemical compound that originated from crude oil, there rate of hazards reflects the simulation results that was expressed in all the figures, the dispersions were a significant parameter that were also observed to monitor and to determine their rates of spread in the soil through infiltration percolation and to the recharge zone in Phreatic beds, therefore permeability determine the flow dynamics in the soil structure through microstructural depositions that reflects on the spread of the contaminants as it is expressed in exponential phase on the figures..

5. Conclusion

The depositions of TPH in soil and water environment were thoroughly evaluated through modeling and simulations. The study expressed different ways that formation characteristics influence the dispersion rates, infiltration percolation and migration rates to Phreatic beds were evaluated in the study, the system were able to monitor their rates of transport through infiltration from the verdose zone to Phreatic depositions, such condition observed from the graphical representation were monitored through simulation used. The significant variables to the system were expressed through transport process of TPH in soil and water environment. Also, the dispersions and velocities in heterogeneous conditions were monitored. These were carried out in other to monitor the impact on the infiltration and percolation of TPH as a contamination integrated with fluids, observed in the soil from the verdose zone to the Phreatic beds. Diffusion was also monitored in the system, the impact of diffusion within the verdose and Phreatic depositions were determined in soil and water environments. These variables have shown to have significant impact in the transport process. Comparing Total petroleum hydrocarbon (TPH) values that range from 300mg/kg to1000mg/kg which is greater than that of groundwater definitely depend on the deposited protection zones, which ranged from 200mg/kg in soil that is highly protected area to 1200mg/kg for verdose zone and groundwater deposition (.>5m). The permissible limitation compared to the predictive values as displayed in figure one to five ranged from 1300mg/kg – 1618mg/kg while figures 6-10 ranged from 30mg/kg-35mg/kg, this implies that five locations from the figures are above the permissible limit while five other locations, figures 6-10 are within the permissible limit.

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