

Ground Water Quality Assessment Near Athipattu Dumpsite Site, India

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ABSTRACT: Due to rapid urbanization the developing countries are facing a great problem in disposing the municipal solid waste. The collected solid waste is dumped directly on open barren lands. During rainy season the surface run off passes through the solid waste and penetrates into the ground surface which contaminates the ground water. The Greater Chennai Corporation is divided into 15 zones, Out of which the dump site at Athipattu, Ambattur is considered to be the most oldest and largest dump site in the Central region of Chennai. The Leachate carries Chemicals and metals and when gets dissolved in ground water, contaminates the ground water. This ground water taken from open wells and when being consumed by people, it causes various health problems. In this study the level of contamination in ground water around the Athipattu dump site was assessed. For this study twelve number of ground water samples were collected for every 100m from dump site. The Water Sample from open Wells were collected in four quarters for a year i.e. during the month of Jan. (1st quarter), April (2nd quarter), July (3rd quarter) and October (4th quarter) at an distance of 100m, 200m, 300m, 400m, 500m, 600m, 700m, 800m, 900m, 1000m, 1100m, 1200m from Athipattu dump site. The following tests such as pH, TS, Hardness, Sulphates, Chlorides, Iron, Sodium & Potassium were carried for the samples collected. The result showed that water samples of open wells were contaminated. Therefore this open landfill is a threat for the human society and for ecology. The ground water collected is found to be contaminated when compared to WHO standards and hence it cannot be used for drinking purpose

KEYWORDS: Solid waste, Leachate, Ground water, Water quality

I. INTRODUCTION

Ground water is an important Source of Natural resource. The ground water is mainly used for drinking and domestic purpose. The ground water gets contaminated when pollutants are disposed directly on to the ground. This pollutant slowly percolates through the soil strata and gets dissolved into the ground water resulting in contamination. The ground water pollution is mainly due to open dumping of Municipal solid waste, run off effluent from waste water and sewerage treatment plants, run off effluent from various industries, leakages from sewer mains, over utilization of fertilizers and pesticides on farm lands. The dumping of Municipal Solid waste in open barren land created a huge threat to human and wild life. The Municipal Solid waste consists of various kinds' waste which is hazardous to our environment. After the dumping process a harmful pollutant gets generated from the decomposition of the solid waste which is known as Leachate. This leachate slowly seeps through the soil and reaches the aquifer. The contamination level of ground water will be high at the area around the dumpsite and the rate of pollution changes based on the seasonal variations. In rainy season, water gets mixed into the waste and most of the chemicals and decomposed Material dissolve in water and start leaching. This leachate creates the problem of ground water contamination. The following are the parameter analyzed to assess the water quality: Chemical parameters: pH, Total solids, Total dissolved solids, Total suspended solids, Inorganic solids, Organic solids, Total Hardness, Chlorides, Sulphates, Iron, Sodium Potassium.

II. Methods and Materials

2.1 Area of Study

Ambattur is a part of Chennai Corporation numbered as Zone 7 out of the 15 zones. It is located in Ambattur taluk of the Chennai district. Ambattur covers an area of 43.52 Sq.km with a population of 481921 nos. Athipattu dumping site is located at vanagaram main road. The Athipattu dump site covers an area of about 100 grounds; the dumping activity is being carried out from Ambattur Municipality to till date. The Ambattur Municipality was made a part of Greater Chennai Corporation in the year 2011.

2.2 Generation of Solid Waste

Daily an average of 360MT of Garbage is dumped at the Athipattu site. The Ambattur zone is divided into 15

divisions starting from division 79 to 93. There are about 89347 houses and 143134 households in the 15 divisions.

Table.1. The per capita generation of Solid waste is 400gms and garbage generation for each division is given as follows.

S.No	Division No	Average Garbage Generation
1	79	15
2	80	17
3	81	30
4	82	20
5	83	24
6	84	26
7	85	16
8	86	55
9	87	20
10	88	21
11	89	20
12	90	23
13	91	25
14	92	25
15	93	23
Total		360 MT/day

Therefore, the total solid waste generation per day in Ambattur is calculated as 306MT/day. The dump site consists to Bio-degradable & Non-Bio- degradable waste such as plastic, Clothes, thermocoal, rubber, wood, metal pieces and E-waste. At present a Bio-methanation plant and Compost yard is constructed at the dump site to convert Bio-degradable waste into Electrical Energy & Manure.

2.3 Generation of Leachate

Due to the continuous disposal of municipal solid waste at Athipattu dump site, huge quantity of Leachate is generated and gets stagnated in and around the dump site. This leachate stagnation percolates into ground water and contaminates the existing ground water in and around the dumpsite. During Monsoon season, the surface runs off flows through the solid waste and generates huge quantity of Leachate. This leachate when percolates result in higher concentration of contaminates in the ground water during the monsoon period.

Table.2. Characteristics of leachate sample collected at dump site

Parameters	Unit	Result
Color	HU	100
Odour	—	Objectionable
Total Suspended Solids	mg/l	3260
Particle Size of Suspended Solids	—	Does not pass through IS 850 Micron Sieve
Total Dissolved Solids	mg/l	27586
pH @ 25c	C	7.9
Temperature	mg/l	29.7
Oil & Grease	mg/l	< 2
Total Residual Chlorine	mg/l	BDL (DL : 0.1)
Ammonical Nitrogen as N	mg/l	804
Total Kjeldahl Nitrogen as N	mg/l	1074
Free Ammonia as NH3	mg/l	522
Biochemical Oxygen Demand (BOD)	mg/l	4600
Chemical Oxygen Demand (COD)	mg/l	13658
Hexavalent Chromium as Cr6+	mg/l	BDL (DL : 0.01)
Percent Sodium	%	0.57

Residual Sodium Carbonate	mg/l	Nil
Cyanide as CN	mg/l	BDL (DL : 0.01)
Chloride as Cl	mg/l	13845
Fluoride as F	mg/l	30.2
Dissolved Phosphate as P	mg/l	37
Sulphate as SO ₄	mg/l	1601
Sulphide as S	mg/l	BDL (DL : 0.01)
Phenolic Compound as C ₆ H ₅ OH	mg/l	BDL (DL : 0.001)
Boron as B	mg/l	0.2
Arsenic as AS	mg/l	BDL (DL : 0.05)
Cadmium as Cd	mg/l	BDL (DL : 0.02)
Total Chromium as Cr	mg/l	BDL (DL : 0.1)
Copper as Cu	mg/l	4.82
Lead as Pb	mg/l	BDL (DL : 0.05)
Mercury as Hg	mg/l	BDL (DL : 0.01)
Nickel as Ni	mg/l	0.12
Zinc as Zn	mg/l	4.56

2.5 Ground Water Sample Collection

Due to the continuous dumping of garbage at Athipattu dump site the harmful leachate contaminants percolates to the ground water, resulting in the contamination of ground water. Till date no precautionary measures or Sanitary landfill methods have been adopted to prevent the ground water contamination. For this study 12Nos of ground water samples G1, G2, G3, G4, G5, G6, G7, G8, G9, G10, G11, G12 are to be collected and tested for 4times a year namely post monsoon, summer, winter, during Monsoon. This type of sampling is carried out to study the variations in contamination levels in ground water near the dump site during various seasons in a year.

Table. 3. Testing of water Samples around the Athipattu Dumping Site – (In the Month January)

Parameters	Unit	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12
pH	_	7.4	7.5	7.5	7.4	7.3	7.3	7.2	7.2	7.1	7.0	6.9	6.9
Total Solids	mg/l	2394	2372	2351	1632	1464	1326	1243	1108	1101	1328	1474	1486
Total dissolved solids	mg/l	2411	2320	2254	2219	1126	1104	1058	970	956	1329	1438	1447
Total Suspended Solids	mg/l	61	52	50	304	338	346	121	138	145	68	36	32
Organic Solids	mg/l	178	172	168	246	380	371	266	234	219	151	98	82
Inorganic Solids	mg/l	2248	2200	2104	1091	1084	1054	982	874	851	1331	1376	1382
Total Hardness	mg/l	76	22	35	42	50	68	34	22	18	15	12	10
Acid Insoluble	mg/l	389	377	361	345	326	303	357	370	382	401	429	442
Calcium Hardness	mg/l	259	244	230	194	177	168	251	243	221	242	259	264

Magnesium Hardness	mg/l	145	133	126	133	148	134	138	126	120	152	170	161
Carbonate Alkalinity	mg/l	134	60	54	44	37	33	31	30	27	Nil	Nil	Nil
Bicarbonate Alkalinity	mg/l	473	453	421	252	231	227	257	268	242	301	312	315
Total Alkalinity	mg/l	594	513	502	254	268	274	283	298	289	301	312	317
Chlorides	mg/l	597	592	586	474	409	401	346	227	219	326	315	304
Sulphates	mg/l	573	494	486	278	160	154	159	164	176	375	383	389
Iron	mg/l	7	–	–	–	–	–	–	–	–	368	454	532
Sodium	mg/l	462	329	301	134	141	136	74	87	91	142	154	158
Potassium	mg/l	52	49	44	32	11	16	28	25	22	18	12	10

Table.4. Testing of water Samples around the Athipattu Dumping Site – (In the Month April)

Parameters	Unit	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12
pH	–	8.10	8.30	8.32	7.81	7.51	7.42	7.38	7.34	7.23	7.30	7.35	7.39
Total Solids	mg/l	2343	2306	2285	2013	1192	1105	1010	882	851	1584	1560	1531
Total dissolved solids	mg/l	2291	2284	2254	1193	1180	1145	901	864	827	1498	1478	1432
Total Suspended Solids	mg/l	27	22	19	15	12	9	13	18	21	64	82	85
Organic Solids	mg/l	132	128	119	104	100	87	81	76	64	110	122	128
Inorganic Solids	mg/l	2182	2178	2162	2051	1092	1054	819	806	794	1542	1438	1384
Total Hardness	mg/l	26	68	54	52	44	35	38	28	21	27	24	23
Acid Insoluble	mg/l	264	255	232	321	317	304	316	309	293	419	409	401
Calcium Hardness	mg/l	132	124	119	172	162	153	218	209	196	229	224	219
Magnesium Hardness	mg/l	142	131	121	162	155	134	105	100	91	198	185	174

Carbonate Alkalinity	mg/l	68	126	116	48	37	25	38	30	26	61	52	48
Bicarbonate Alkalinity	mg/l	462	462	451	248	194	184	156	149	124	219	201	192
Total Alkalinity	mg/l	521	588	564	242	231	225	187	179	168	264	253	246
Chlorides	mg/l	397	390	387	386	385	376	214	203	196	274	263	258
Sulphates	mg/l	498	563	542	151	143	134	169	165	153	458	451	432
Iron	mg/l	0	4	5	3	1	1	1	1	1	8	13	10
Sodium	mg/l	337	454	441	354	202	198	154	102	98	221	218	214
Potassium	mg/l	42	33	28	15	13	10	42	40	34	18	14	12

Table.5. Testing of water Samples around the Athipattu Dumping Site – (In the Month July)

Parameters	Unit	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12
pH	–	8.2	7.84	7.82	7.765	8.25	8.36	7.75	8.055	7.825	7.905	7.845	7.81
Total Solids	mg/l	1676	1281	941.5	1198	1920	1913	1315	1773	1541	1180	1292	1085
Total dissolved solids	mg/l	1650	1226	933	1162	1909	1869	1259	1328	1501	1157	1242	1087
Total Suspended Solids	mg/l	13.5	6.5	9	39.5	11	37.5	32	34	41	6	42.5	4.5
Organic Solids	mg/l	126	124.5	95.5	123.5	147	150.5	116	142	138	122.5	127	104.5
Inorganic Solids	mg/l	1535	1097	839.5	1079	1773	1760	1217	1697	1396	1074	1155	984
Total Hardness	mg/l	49	26	24	17.5	40	33	25.5	31	16.5	30	20.5	25.5
Acid Insoluble	mg/l	306	340.5	320	376	309	344	384	381.5	382.5	322.5	362.5	311
Calcium Hardness	mg/l	166.5	199.5	200.5	242	151	202.5	216.5	206	194.5	159.5	186.5	150.5
Magnesium Hardness	mg/l	144.5	148.5	118	135	158	145.5	175	163	183	163.5	172	149
Carbonate Alkalinity	mg/l	104	36	49.5	65.5	78	106.5	69	69.5	39.5	44	48	33.5

Bicarbonate Alkalinity	mg/l	363	210	196	183	361	344.5	238.5	234.5	227	188	184	178
Total Alkalinity	mg/l	460.5	256	241.5	257	454	449.5	297.5	283	234	256	259	246.5
Chlorides	mg/l	346.5	336	242.5	241	420	332	287.5	322	352.5	376.5	309	364.5
Sulphates	mg/l	367	229	158.5	347.5	424	535	316	332.5	362.5	153.5	295.5	142.5
Iron	mg/l	3.655	0.5	0.615	0.79	2	2.76	4.21	1.725	6.5	0.5	5	0.5
Sodium	mg/l	280.5	161.5	94	259.5	309.5	427.5	161.5	381	186	162.5	165	153.5
Potassium	mg/l	28	27	26	22.5	21.5	18.5	13.5	11.5	11	10	9	7.5

Table.6. Testing of water Samples around the Athipattu Dumping Site – (In the Month October)

Parameters	Unit	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12
pH	–	8.3	8.3	8.3	8.3	8.2	8.4	8.2	8.3	8.3	8.3	8.3	8.2
Total Solids	mg/l	1008	1552	1001	1545	1534	1540	1046	1532	1521	1168	1052	1064
Total dissolved solids	mg/l	1008	1551	1002	1496	1534	1484	1019	1462	1523	1134	1052	1029
Total Suspended Solids	mg/l	0	0	0	58	0	56	0	53	0	0	0	0
Organic Solids	mg/l	120	168	115	183	166	182	122	180	154	145	126	122
Inorganic Solids	mg/l	888	1374	873	1364	1368	1358	891	1342	1354	1056	926	914
Total Hardness	mg/l	22	14	20	14	12	12	24	10	9	16	18	16
Acid Insoluble	mg/l	348	365	331	459	363	456	349	442	356	328	324	318
Calcium Hardness	mg/l	201	181	192	288	178	286	204	240	165	157	154	148
Magnesium Hardness	mg/l	147	192	136	179	185	170	152	164	181	172	170	164
Carbonate Alkalinity	mg/l	74	34	69	105	30	97	77	91	27	51	48	42
Bicarbonate Alkalinity	mg/l	253	264	243	242	260	238	258	221	253	182	176	172
Total Alkalinity	mg/l	327	325	304	346	320	335	331	324	215	281	272	268
Chlorides	mg/l	296	458	282	286	450	277	301	258	442	368	360	353
Sulphates	mg/l	161	289	152	542	285	528	174	514	274	164	159	151
Iron	mg/l	0.31	0	0.23	0.58	0	0.52	0.42	0.45	0	0	0	0

Sodium	mg/l	99	169	86	421	165	414	102	408	154	123	116	109
Potassium	mg/l	14	12	12	11	10	9	9	8	8	7	6	5

III. Conclusion

The quality of groundwater at Athipattu dumpsite, Chennai, Tamil Nadu was assessed. The result shows that the Impact of leachate on ground water quality near Athipattu dumping site is high during the post monsoon period.

From the above study it is found that some Chemical parameters are found above the permissible limits for drinking water such as Total dissolved solids, Calcium & Magnesium Carbonate, Total Alkalinity, Chlorides, Sulphates & Iron when compared with the permissible limits of IS 10500:2012 and WHO Standard.

However, feasible technology can be adopted in treating the ground water against the following parameters. The possible treatments which are suggested are Reverse Osmosis, Distillation, deionization by ion exchange, Filtration method, Oxidizing Filter, Green-sand Mechanical Filter, Water Softener Ion Exchanger, Reverse Osmosis, Neutralizing agent (i.e. nanofiltration, lime softening) Reverse Osmosis, Distillation, Activated Carbon, Ion Exchange, Distillation, Reverse Osmosis

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