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A Study on Physico-Chemical Characteristics of Groundwater in the Industrial Zone of Visakhapatnam, Andhra Pradesh.

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Abstract: - An attempt is made in the present study to assess the groundwater quality in the industrial zone of Visakhapatnam, a port city. Groundwater samples collected from 114 sampling locations covering uniformly the entire industrial zone of the city are analysed for various physico-chemical characteristics to assess the groundwater quality. From the analysis, it is observed that the port area is found to have high concentrations of hardness, sulphates and calcium. The groundwater in Duvvada, a region surrounded by special economic zone and steel plant is found have more fluoride concentrations. Since, the study is conducted only for one year period, it is suggested to extend the study for more number of years continuously, with due consideration to various hydrological features, so that an authentic conclusion on the quality of groundwater can be made.

Key words: - *Groundwater quality, Physico-chemical characteristics, Hydrological features.*

I. INTRODUCTION

Water is an essential element of nature for the sustenance of life on the planet earth. It is available in the forms as surface water and sub-surface water or groundwater. Surface water is predominantly used for public water supply systems. However, the rapid growth of population and the resultant increased demand of water, necessitated for the usage of groundwater to augment the existing water supply systems, in most of the cities in the country. Secondly, the growing urbanization and industrialization and the consequent pollution of surface water sources, also increased the necessity of using groundwater for various domestic and industrial purposes.

Since, groundwater is occupying a major portion of water supply for both domestic and industrial purposes nowadays, it is highly essential that, its quality should match the domestic water standards. But in most of the industrial cities, the indiscriminate disposal of industrial wastes on to the land is resulting in the deterioration of groundwater quality due to the leachates from these wastes[1] [2][3][5]. However, due to the paucity of sufficient surface waters, invariably the people are thriving upon the groundwater sources to meet their water requirements. Hence, if groundwater sources are to be suggested for various uses, its quality should be assessed [6][4].

Visakhapatnam, the fastest developing industrial city of Andhra Pradesh, is no exception w.r.t. to the increased usage of groundwater for domestic and industrial purposes as well as the degradation of its quality due to the improper disposal of industrial wastes. Hence, an attempt is made in the present work to assess the groundwater quality in the industrial zone of Visakhapatnam city, keeping in view of the increased usage of groundwater in the recent times.

II. METHODOLOGY

A reconnaissance survey is conducted in the industrial area of the Visakhapatnam city with the help of a layout plan of the region, obtained from Greater Visakhapatnam Municipal Corporation (GVMC) in order to fix up the study area. The study area comprised of different parts of Visakhapatnam city spreading from ward numbers 40 to 72, where almost all large and small scale industries are located. The sampling points are located in such a way that, they are uniformly distributed in all the wards of the study area. 114 sampling locations are fixed up for sampling. Mostly, bore wells are considered for sampling. At certain places a few open wells and hand pumps are also considered for the sampling. Water samples are collected from each sampling point and are analysed for the parameters Viz., pH, Conductivity, Turbidity, Alkalinity, Hardness, Chlorides, Fluorides, TDS, Dissolved Oxygen, Iron, Sulphates, Calcium and Nitrogen as per the standard procedures.

III. RESULTS AND DISCUSSIONS

The results of the study are presented in the following table no.1. The following observations are made from the results.

1. The pH of the samples is found to be varying from a minimum value of 6.2 to a maximum value of 9.2. The maximum values are found in ward nos. 67, 68 and 70.
2. Conductivity is found to be more in the wards 45, 49, and 58 indicating high TDS concentration in groundwater of these areas. Conductivity varied from a minimum of 260 micro-seimans to a maximum of 2200 micio-seimans.
3. Turbidity is found to vary from 0.5. NTU to 0.79 NTU with an average value of 0.62 NTU.
4. Alkalinity is found to be more in the wards 67, 68 and 70 and varying from a minimum of 352 mg/l to a maximum of 892 mg/l.
5. Hardness is found to be more in the ward 25 which covers port areas. The maximum and minimum values are found to be 1398mg/l and 92mg/l.
6. Chloride concentration is varied from a minimum of 11mg/l to a maximum of 332mg/l.
7. Fluoride concentration is varied from a minimum of 1.02mg/l to a maximum of 1.65mg/l and it is found to be more in ward no. 57 and 58 covering Duvvada and Steel plant regions.
8. TDS is found to vary from 600mg/l to 1920mg/l with maximum values appearing in wards 45, 49 and 58.
9. D.O levels are found to be in the permissible limits and they varied from a minimum of 4.02mg/l to maximum of 8.2mg/l.
10. Iron is found to vary from a minimum of 0.31mg/l to a maximum of 0.76mg/l.
11. Sulphates are found to be more in the port area. They varied from a minimum of 12mg/l to a maximum of 144mg/l.
12. Calcium is also found to be more in port area and steel plant. It varied from 4.9mg/l to 164mg/l.
13. Nitrates, the analysis of which is done keeping in view of large scale industries dealing with organics, are found to vary from a minimum of 10mg/l to a maximum of 68.5mg/l.

IV. CONCLUSIONS AND SUGGESTIONS

1. pH, Conductivity, Alkalinity and Turbidity are found to be within the permissible limits, over the entire study area.
2. Chlorides and Iron are also found to be in acceptable limits.
3. Hardness, Calcium and Sulphates are found to be more than the permissible limits in the wards covering the entire port area.
4. Nitrates are found to be in permissible limits except in ward no. 45.
5. Fluoride is found to be exceeding the permissible limit of 1.5 mg/l in the region surrounding steel plant.
6. Since the study is conducted for a period of one year only, it is suggested to extend the study for more number of years and covering all seasons, in order to make more authentic conclusions.

REFERENCES

[1] **A.K. Sinha and Kamala Kant** "Underground water quality and its impact on the health of its users in Sarani Block of Rae Bareli" IJEP, 23(9):pp.1017-1024(2003)

[2] **Anuraag Mohan, Kinty Pandey, R.K. Singh and Vineet Kumar.** "Assessment of Underground water quality in industrial area of Bareilly" IJEP, 26(2):pp.153-158(2006)

[3] **D. Buddhi, Punam Tyagi, R.L.Sawhnay and Richa Kothani.** "Groundwater Quality of Pithampur Industrial area: Opinion survey of the residents" IJEP, 24(3):pp.167-172(2004)

[4] **G.R.Chaudhari , Deepali Sohani and V.S. Shrivastava** "Groundwater Quality Index near Industrial Area"

[5] IJEP, 24(1):pp.29-32(2004)

[6] **G.V.Pandian , N. Kannan, K. Paulraj and S. Paulrajan** "Effect of Industrial Pollution on ground water in Madurai Suburban Area" IJEP, 26(10):pp.939-945(2006)

[7] **K. Karunakaran , A. Samoon Nesaraj, S. Manjunatha, A.Doorty, M. Raja and D. Srividhya.** "A study on the Physico-chemical characteristics of groundwater in Salem Corporation. IJEP, 25(6):pp.510-512(2005)

S.No.	Parameter / Sample No.	p^H	Conductiv-ity (µs)	Turbidity (N.T.U.)	Alkalinity (mg/las $CaCo_3$)	Hardness (mg/las $CaCo_3$)	Chlorides (mg/l)	Fluorides (mg/l)	TDS(mg/l)	D.O. (mg/l)	Iron (mg/l)	Sulphates (mg/l)	Calcium (mg/l)	Nitrates (mg/l)
1	25/S1(B-2)	7.30	673	0.62	492.0	1064	262	1.25	872.2	4.02	1.146	109.2	136.98	68.5
2	25/S2(B-4)	7.20	1043	0.79	482.0	1398	164	1.29	1132.0	6.93	0.564	142.6	166.54	11.27
3	25/S3(B-7)	7.16	892	0.60	476.0	983	173	1.27	1030.6	6.24	0.702	101.1	129.19	37.44
4	41/S1(B-18)	6.84	920	0.51	443.2	320	137	1.15	1049.1	7.34	0.480	34.8	69.52	22.04
5	41/S2(B-09)	6.81	1083	0.73	437.0	393	193	1.21	1152.0	6.02	0.740	42.1	76.09	40.52
6	41/S3(B-14)	6.62	983	0.64	423.0	415	144	1.16	1062.3	7.94	0.360	44.3	78.07	13.64
7	42/S1(BW2)	6.70	1310	0.58	431.0	600	106	1.34	1356.1	8.20	0.310	62.8	94.72	10.00
8	42/S2(W-1)	6.40	1134	0.57	429.7	312	83	1.29	1293.0	6.30	0.380	34.0	68.80	36.60
9	42/S3(BW1)	6.90	1340	0.59	469.2	448	164	1.28	1368.3	7.30	0.490	47.6	81.04	22.60
10	42/S4(B-02)	6.72	1234	0.58	443.0	372	89	1.31	1298.3	7.90	0.370	40.0	74.20	14.20
11	42/S5(W25)	8.88	1140	0.54	673.40	470	109	1.35	1178.3	5.72	0.80	49.8	83.0	45.0
12	42/S6(W-2)	7.23	1100	0.63	491.30	401	72	1.26	1171.6	8.00	0.35	42.9	76.8	12.8
13	42/S7(W24)	6.20	1000	0.59	373.60	360	92	1.37	1103.5	6.30	0.69	38.8	73.1	36.6
14	43/S1(W-6)	7.10	914	0.57	485.40	334	143	1.29	1046.3	6.45	0.66	36.2	70.7	33.8
15	43/S2(B-21)	7.09	973	0.66	480.30	372	153	1.45	1058.3	6.93	0.56	40.0	74.2	28.2
16	44/S1(W-7)	7.03	934	0.73	478.92	401	167	1.16	1058.3	7.45	0.46	42.9	76.8	19.8
17	44/S2(B-25)	7.03	1083	0.62	478.92	412	274	1.35	1152.0	6.34	0.68	44.0	77.8	36.6
18	45/S1(BW2)	7.20	1400	0.52	492.30	456	192	1.29	1421.9	4.20	1.11	48.4	81.7	66.0
19	45/S2(BW3)	6.96	1100	0.65	469.32	482	127	1.46	1171.6	470	1.01	51.0	84.1	59.0
20	45/S3(BW9)	7.67	110	0.68	812.83	416	157	1.39	1171.6	4.90	0.97	44.4	78.1	56.2
21	45/S4(B-11)	7.60	980	0.62	573.3	436	178	1.26	1090.0	4.8	0.99	64.8	79.9	57.6
22	45/S5(B48)	6.87	1010	0.67	452.3	476	124	1.17	1110.3	4.9	0.97	50.4	83.5	56.2
23	45/S6(B56)	7.28	2000	0.54	493.4	644	210	1.32	1784.0	4.8	0.99	67.2	98.6	57.6
24	45/S7(B57)	7.19	2010	0.61	484.3	652	215	1.19	1790.8	4.7	1.01	68.0	99.4	59.0
25	45/S8(B60)	6.90	900	0.54	471.0	440	180	1.34	1035.5	4.4	1.07	46.8	80.3	63.2
26	45/S9(B65)	6.94	1000	0.57	476.3	484	118	1.16	1103.6	5.3	0.81	51.2	84.2	50.6
27	45/S10-B73	6.96	1010	0.58	478.1	448	126	1.17	1110.3	4.9	0.94	47.6	81.1	56.2
28	46/S1(B85)	7.10	1040	0.66	481.3	356	105	1.22	1130.8	5.4	0.87	48.4	72.7	49.2
29	46/S2(B93)	7.08	1030	0.61	480.5	504	165	1.25	1123.9	5.3	0.89	53.2	86.1	50.6
30	46/S3(BW-103)	6.83	1560	0.64	471.3	444	152	1.16	1484.6	5.2	0.91	47.2	80.6	52.0
31	46/S4(BW-104)	7.12	1040	0.57	483.4	472	123	1.18	1130.8	5.5	0.85	50.0	83.2	47.8
32	46/S5(BW-126)	7.02	1290	0.69	480.4	484	195	1.15	1301.0	4.9	0.97	51.2	84.2	56.2
33	46/S6(BW-128)	7.14	1090	0.71	484.5	456	172	1.24	1165.0	5.6	0.83	48.4	81.7	46.4
34	46/S7(BW-131)	7.18	960	0.52	486.7	356	110	1.36	1076.0	4.4	1.07	38.4	72.7	63.2
35	46/S7(BW-135)	6.92	1070	0.66	477.5	408	155	1.27	1151.0	5.8	0.79	43.6	77.4	43.6
36	46/S9(BW-136)	6.98	1220	0.68	478.1	456	165	1.36	1253.3	5.3	0.89	48.4	81.7	50.6
37	47/S1(BW-100)	6.90	1010	0.62	477.9	480	187	1.24	1110.3	5.6	0.83	50.8	83.9	46.4
38	47/S2(BW-101)	7.01	940	0.52	480.3	408	164	1.36	1062.5	5.4	0.87	43.6	77.7	49.2
39	47/S3(BW-110)	7.09	990	0.61	480.1	488	190	1.45	1096.7	4.2	1.11	51.6	84.6	66.0
40	47/S4(BW-118)	6.84	1100	0.58	464.3	424	182	1.38	1171.6	4.6	1.03	45.2	78.8	60.4
41	47/S5(BW-123)	6.89	1180	0.64	414.5	396	140	1.37	1249	5.2	0.91	42.4	76.3	52.0
42	48/S1(BW-78)	6.84	900	0.62	384.4	484	110	1.26	1034	5.3	0.89	51.2	84.3	50.6
43	48/S2(BW-81)	6.92	1100	0.64	419.7	564	180	1.31	1171	5.6	0.83	59.2	91.4	46.4

44	48/S3(BW-88)	6.89	980	0.62	414.5	432	125	1.25	1086	5.8	0.79	46.0	79.6	43.6
45	48/S4(BW-91)	7.12	970	0.70	453.9	456	134	1.32	1081	5.9	0.77	48.4	81.7	42.2
46	48/S1(BW6)	7.14	2200	0.57	477.4	423	135	14.2	1920	5.3	0.89	45.1	78.8	50.6
47	49/S2(BW-15)	6.90	2000	0.58	416.2	420	162	1.34	1783	5.1	0.93	44.8	78.5	53.4
48	49/S3(BW-22)	7.01	2200	0.56	435.1	436	181	1.19	1920	4.6	1.03	46.4	79.9	60.4
49	49/S4(BW-24)	7.07	2010	0.59	445.4	435	139	1.27	1790	5.1	0.93	46.3	79.8	53.4
50	49/S5(BW-35)	7.06	2080	0.61	443.7	442	145	1.29	1825	5.6	0.83	47.0	80.5	50.6
51	49/S6(BW-41)	7.11	2110	0.56	482.7	429	131	1.26	1858	5.5	0.85	45.7	79.3	47.8
52	49/S7(BW-76)	7.04	1040	0.59	476.8	436	130	1.31	1130	5.2	0.91	46.4	79.9	52.1
53	53/S1(BW5)	6.74	841	0.66	451.7	436	86	1.28	995	5.3	0.89	46.4	79.9	50.6
54	57/S1(BW-19)	6.8	1320	0.56	464.1	240	124	1.6	1321	5.6	0.83	26.8	62.3	46.4
55	57/S2(BW-13)	6.80	1232	0.69	464.1	434	20	1.52	1261	6.4	0.67	46.4	79.7	35.2
56	57/S3(BW-17)	7.0	1060	0.59	478.3	235	141	1.49	1144	5.5	0.85	26.3	61.8	47.8
57	57/S3(T-2)	7.0	1120	0.62	478.3	260	106	1.35	1185	5.4	0.87	28.8	64.1	49.2
58	58/S1(DW)	7.05	1156	0.61	478.9	256	121	1.62	1209	5.6	0.83	28.4	63.7	46.4
59	58/S2(B-02)	6.9	1420	0.58	478.1	230	135	1.54	1389	5.2	0.91	25.8	61.4	52.0
60	58/S3(BW4)	7.0	940	0.68	478.3	290	98	1.49	1062	5.6	0.83	31.8	66.8	46.4
61	58/S4(BW7)	7.00	1340	0.62	478.3	285	154	1.65	1368.3	5.8	0.79	31.3	63.3	43.6
62	58/S5(BW8)	6.90	900	0.59	478.1	270	174	1.59	1039.3	5.7	0.81	29.8	65.0	45.0
63	58/S6(BW9)	6.80	1540	0.58	464.1	265	86	1.61	1513.4	5.4	0.87	29.3	64.5	49.2
64	58/S7(W-1)	6.70	920	0.62	463.3	400	106	1.57	1049.3	6.1	0.73	42.8	76.7	39.4
65	58/S8(W-3)	6.90	2100	0.59	478.1	245	110	1.49	1851.9	5.2	0.91	27.3	62.8	52.0
66	59/S1(BW-12)	7.03	1010	0.56	476.2	576	58	1.23	1110.3	7.6	0.43	60.4	72.5	18.4
67	59/S2(BW-24)	6.80	1230	0.62	464.1	408	70	1.34	1262.5	8.1	0.33	43.6	77.4	11.4
68	59/S3(BW-25)	6.90	830	0.64	478.1	392	306	1.24	998.6	6.6	0.63	42.0	76.0	32.4
69	60/S1(B-1)	7.41	1062	0.56	492.3	368	77	1.02	1155.3	5.1	0.93	39.6	75.4	53.4
70	60/S2(B-3)	7.36	1035	0.53	488.9	356	74	0.99	1136.9	5.0	0.95	38.4	72.7	54.8
71	60/S3(B-5)	7.32	998	0.57	487.8	456	80	1.08	1102.2	5.3	0.89	48.4	81.7	50.6
72	61/S1(B-9)	7.32	1015	0.53	487.8	436	92	1.15	1113.7	5.4	0.87	46.4	79.9	49.2
73	61/S2(B-12)	7.43	1146	0.56	492.7	430	87	1.29	1203.0	6.5	0.65	45.8	79.4	33.8
74	61/S3(B-13)	7.40	1106	0.55	492.8	436	84	1.34	1175.7	6.2	0.71	46.4	79.9	38.0
75	61/S4(B-15)	7.39	1099	0.54	492.6	416	89	1.19	1171.0	5.9	0.77	44.4	78.1	42.2
76	61/S5(B-17)	7.45	1210	0.57	493.0	456	96	1.36	1246.7	7.0	0.55	48.4	81.7	26.8
77	61/S6(B-19)	7.42	1123	0.55	492.9	448	92	1.49	1157.3	6.8	0.59	47.6	81.0	29.8

78	63/S1(BW-16)	7.20	890	0.59	479.9	520	84	1.17	1028.7	6.4	0.67	54.8	87.5	35.2
79	63/S2(BW-26)	7.01	930	0.68	478.8	488	184	1.08	1056.0	5.9	0.77	51.6	92.7	42.2
80	64/S1(BW-142)	7.1	956	0.69	479.0	471	159	1.29	1073.6	6.2	0.71	49.9	83.1	38.0
81	64/S2(BW138)	7.12	941	0.65	479.3	479	141	1.37	1042	6.4	0.67	50.7	83.8	35.2
82	65/S1(BW18)	6.90	1190	0.59	478.1	480	110	1.29	1280	6.8	0.59	50.8	83.9	29.6
83	65/S2(BW-6)	6.72	1010	0.54	463.9	520	109	1.46	1125	6.9	0.57	54.8	87.5	28.2
84	65/S3(BW-7)	7.14	1090	0.62	479.5	680	258	1.05	1153	7.6	0.43	70.8	102.2	18.4
85	65/S4(BW-9)	6.96	1140	0.71	478.9	600	182	1.31	1178	7.4	0.47	62.8	94.7	21.2
86	65/S5(B11)	7.19	1200	0.59	479.0	424	256	1.08	1286	7.2	0.51	40.2	68.9	24.0
87	67/S1(W-04)	7.32	600	0.72	487.8	412	251	1.06	856	6.20	0.71	44.0	78..8	38.0
88	67/S2(W-07)	8.45	220	0.53	676.3	372	78	1.24	572	5.03	0.94	40.0	74.2	54.8
89	67/S3(W-11)	8.65	630	0.50	684.0	92	43	1.50	851	6.90	0.57	12.0	49.0	28.2
90	67/S4(W-14)	8.22	744	0.53	651.6	120	38	1.05	929	5.70	0.81	14.8	51.0	17.0
91	67/S5(W-39)	8.22	1080	0.53	653.3	216	55	1.14	1179	5.70	0.81	24.4	60.2	45
92	67/S6(W-21)	7.32	600	0.72	487.8	412	251	1.25	856	6.20	0.71	44.0	77.8	38
93	67/S1(W-18)	6.72	983	0.63	463.9	176	46	1.19	1062	5.40	0.87	20.4	64.6	49
94	68/S2(BW2)	7.45	804	0.66	489.0	510	138	1.34	1008	7.30	0.49	53.8	86.6	22
95	68/S3(W-36)	8.48	710	0.69	680.9	336	74	1.26	906	7.40	0.47	36.4	70.9	21
96	68/S4(W-19)	9.22	860	0.67	898.0	256	43	1.35	1015	5.10	0.93	28.4	63.7	53
97	68/S5(W22)	8.35	260	0.65	674.0	292	80	1.14	600	4.90	0.92	32.0	67.0	56
98	69/S1(W-33)	7.41	1210	0.58	589.3	248	20	1.15	1291	6.20	0.71	27.6	63.0	38
99	69/S2(W-34)	7.85	1520	0.59	616.3	96	11	1.24	1503	5.70	0.81	12.4	49.3	45
100	70/S1(W2)	9.13	670	0.56	906.3	248	75	1.26	870	5.60	0.83	27.6	63.0	46
101	70/S2(W1)	9.62	460	0.57	953.0	180	17	1.41	736	6.44	0.66	20.8	56.9	35.2
102	70/S3(W-14)	9.44	1790	0.59	937.3	344	39	1.29	1641	6.20	0.71	37.2	71.6	38.0
103	71/S1(W-31)	8.30	1083	0.63	664.8	348	56	1.28	1160	5.70	0.81	45.9	72.0	45.0
104	71/S2(W-30)	8.30	1080	0.71	664.7	160	23	1.19	1158	6.30	0.69	18.8	51.1	36.6
105	1-3/S1(W1)	7.06	1010	0.58	475.3	440	332	1.46	1110	5.20	0.91	46.8	80.3	52.0
106	1-3/S2(W2)	6.79	1220	0.79	463.0	436	184	1.32	1253	5.30	0.89	46.4	79.9	50.6
107	1-3/S3(B5)	6.89	1310	0.62	466.3	480	152	1.16	1314	5.60	0.83	50.8	83.9	46.4
108	1-3/S4(B6)	6.94	960	0.64	479.9	360	192	1.24	1076	5.40	0.87	38.8	73.1	49.2
109	1-3/S5(B7)	6.84	990	0.62	465.9	356	306	1.32	1096	5.80	0.79	38.4	72.7	43.6
110	1-3/S6(B9)	6.79	1210	0.69	477.4	356	164	1.26	1246	5.90	0.77	38.4	72.7	42.2
111	1-3/S8(W7)	7.00	1090	0.68	478.3	316	110	1.19	1070	5.3	0.89	34.4	69.7	50.6
112	1-3/S9(B15)	6.90	1010	0.58	477.9	356	106	1.08	1110	5.6	0.83	38.4	72.7	46.4
113	1-3/S10(B23)	6.82	1290	0.56	438.9	400	56	1.07	1300	5.4	0.87	42.8	76.7	49.2
114	1-3/S11(W11)	6.85	980	0.54	443.7	360	78	1.27	1091	5.2	0.91	38.8	73.1	52.0
	AVERAGE	**7.01**	**1190**	**0.62**	**490**	**460**	**135**	**1.30**	**1130**	**5.8**	**0.76**	**45.0**	**82.5**	**43.0**