

Assessment of Industrial effluent and underground water during monsoon season 2007 in Sitapura Industrial area, Jaipur

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ABSTRACT

Study of industrial effluents and underground water of Sitapura Industrial Area was carried out during monsoon season 2007. The main purpose of this study was to assess the quality of industrial effluents and its effects on the underground water. Waste water samples were collected from 4 textile, 4 pharmaceutical, 4 printing, 4 food products industries and 3 samples of mixed effluents. Underground water samples were collected at both sites of the nala and nearby different industries. These samples were analysed for the parameters of pH, Electrical Conductivity, Total dissolved solids, Total suspended solids, Total solids, Sodium, Potassium, Chloride, Nitrate, Hardness, Alkalinity, Sulphate, Phosphate, Fluoride, Dissolved Oxygen, Chemical Oxygen Demand. The pH value varied from 6.3 to 8.6 and EC value varied from 1.0 to 3.3 mmho/cm in the industrial effluent. The pH value varied from 7.16 to 9.52 and EC value varied from 1.08 to 3.3 mmhos/cm in the underground water samples. The COD value were found to be from 110 mg/L to 710 mg/L in the industrial effluents.

Key words: Industrial effluents, underground water, Sitapura industrial area.

INTRODUCTION

The industrial effluents may contain one or more of the contaminants like high suspended solids, oil, high dissolved solids, high residual chlorine and pH value outside the permitted range¹. There are many human-originated impacts that degrade the water and decrease its quality, with direct and indirect effects on the water courses. The industries are a source of punctual pollution with considerable impacts on the hydric resources, due to diversity in the composition of the effluents².

Waste from the industry, which is subjected to reaction with percolating rain water and reaches the ground water level. This percolating water picks up a large number of contaminants and reaches the aquifer system and hence degrades the ground water quality³. Disposal of treated & untreated

industrial effluents on land has become a regular practice for some industries. Industries located in Mettupalayam taluk, Tamilnadu dispose their effluents on land and the farmers of the adjacent farmlands have complained that their shallow open wells get polluted & also the salt content of soil has started building up slowly⁴. The fluoride concentration in water of BALCO, Korba area (India) varied from 1.07 ppm to 3.10 ppm causing dental and skeletal fluorosis in that area⁵. A study was carried out in Malawi to assess the extent of chemical pollution in area as affected by industrial effluents. Both the effluents and the water at selected parameter were analysed for pH, dissolved oxygen, biochemical oxygen demand, electrical conductivity, suspended solids, nitrates, alkalinity, hardness, chloride and phosphate in the dry seasons. The results showed that the effluents were acidic in both the dry season (range: 4.2 ± 0.02 –

6.5 ± 0.02) and in the rainy season (range; 4.2 ± 0.05 – 5.6 ± 0.01)⁶. The ground water around the salt pans has been found with the high concentration of TDS, Chloride and Sodium⁷.

In view of above, the Physico-chemical study of industrial effluents and groundwater of Sitapura Industrial Area, Jaipur was carried out during monsoon season and the results are discussed here.

MATERIAL AND METHODS

The samples were collected at the discharge points of different industries while mixed effluent samples were taken from the points where this mixed effluent is discharged into the nearby drain (nala). The industrial effluents of 4 textile industries, 4 pharmaceuticals industries, 4 printing industries, 4 food products industries, 3 samples of mixed effluents and underground water samples were collected at both sites of the nala and nearby different industries. Samples were collected in sterilized bottles. These were systematically analysed. The analysis of these samples were carried out using standard methods^{8,9}.

While chloride, alkalinity, hardness, dissolved oxygen and COD were determined by using titrimetric method, TDS and Suspended solids were determined by gravimetric method. Details of analysis are given in Table-2.

RESULTS AND DISCUSSION

Industrial Effluents: Table-3

pH

A quick evaluation of acidic and alkaline nature of water can be done by the determination

of pH which is an important parameter of water¹⁰. The pH value i.e. 6.3 – 8.6 were found to be under permitted limit of Industrial Effluent Standards¹¹.

Electrical Conductivity

The value of electrical conductivity ranged from 1 to 3.3.

Total Dissolved Solids

TDS values varied from 680 to 2142 mg/L. Which is under permitted limit as per Industrial Effluent Standards¹¹.

Total Suspended Solids

Total Suspended Solids were found in the range of 1.6 to 860.6 mg/L, 240 mg/L of textile industry, 860.6 mg/L of pharmaceuticals industry, 312, 408 and 810 mg/L of printing industries and 160.8, 178 and 230 of food products industries are at higher side as per Industrial Effluent Standards. It should be < 150 mg/L.

Chloride

Chloride value varied from 120.26 to 905.5 mg/L.

Total Alkalinity

Total alkalinity was noted from 200 to 1560 ppm. After data analysis, it is found that alkalinity of 1 pharmaceuticals effluent, 3 food products effluents and 1 mixed effluent are above 1000 ppm.

Sodium and Potassium

The value of sodium and potassium were in the range of 200-795 ppm and 4-55 ppm.

Nitrate

The nitrate values were found from 0.8 to 20 mg/L. The nitrate value are under permitted limit.

Table 1: The following instruments were used for analysis

S.No.	Instruments	Make & Model Number
1	pH meter	Elico L1 120
2	Digital Conductivity meter	CENTURY, CC 601
3.	UV-VIS Spectrophotometer	Systronics, 118
4.	Digital Flame Photometer	ELICO. CL22-D

Sulphate

The sulphate value varied between 26 to 210 mg/L. The value of sulphate of some effluents like 1 textile, 2 printing and 4 food products are above 100 mg/L.

Dissolved Oxygen

It's value were noted from 0.4 - 4.8 mg/L. The dissolved oxygen in some effluents is absent as per result.

Chemical Oxygen Demand

Chemical Oxygen Demand values were found to be 110 to 710 mg/L. Some are in the higher range as per Industrial Effluent Standards¹¹. The value of COD should not exceed 400 mg/L.

Hardness

Hardness found to be from 126 to 420 mg/L.

Phosphorus

The value of phosphorus varied between 1 to 28 mg/L.

Fluoride

The value of fluoride was noted from negligible to 2.86 mg/L.

Under ground water: Table-4**pH**

The pH values were found to be from 7.16 to 9.52. All the pH values are under permissible limit as per Indian Standard and WHO guideline except one i.e. 9.52.

Electrical Conductivity

The value of electrical conductivity ranged from 1.08 to 3.3 mmhos/cm. The variation in electrical conductivity could be explained to the natural concentration of ions present in water. The higher values of conductance (>1000µmhos/cm) may be due to the difference in geographical features¹².

Total Dissolved Solids

TDS values varied from 658.4 to 2130 mg/L. This is under permissible limit as per Indian Standard except two i.e. 2130 and 2030.6 mg/L. The samples have TDS above 500 mg/L but below the maximum permissible limit of 1500 mg/L which can be used for domestic purposes. But if utilized for cooking purposes, the water has a salty taste and produces scales on cooking vessels¹⁰.

Table 2: Parameters and methods employed in the chemical examination of samples

S.No.	Parameters of water analysis	Methods
1	pH	pH meter
2	Electrical Conductivity	Digital Conductivity Meter
3	Suspended Solids	Gravimetric method
4	Total dissolved solids	Gravimetric method
5	Total Solids	Gravimetric method
6	Phenolphthalein Alkalinity	Titrimetric method
7	Total Alkalinity	Titrimetric method
8	Chloride (as Cl ⁻)	Titrimetric method
9	Total Hardness as (CaCO ₃)	Titrimetric method
10	Dissolved Oxygen	Winkler's method
11	Chemical Oxygen Demand	Standard chemical method
12	Nitrate (as NO ₃ ⁻)	Spectrophotometric method
13	Sulphat (as SO ₄ ²⁻)	Turbidimetric method
14	Sodium (as Na ⁺)	Flame Photometer method
15	Potassium (as K ⁺)	Flame Photometer method
16	Phosphorus (as P)	Spectrophotometric method

Table 3: Result of analysis of Industrial effluents during monsoon season 2007

S. No.	Site	Sample No.	pH	Ec mmho /cm	TDS mg/L	TSS mg/L	Total mg/L	Chloride mg/L	Sodium Alkalinity	Potassium ppm	Nitrate ppm	Sulphate mg/L	D.O. hate mg/L	C.O.D. mg/L	Hardness mg/L	P mg/L	Fluoride mg/L	
1	Textile Ind	T.I. - A	8.6	2.11	1380.4	118.38	1498.78	180	740	710	11	8	50	1.8	300	190.6	24	2.44
2	Textile Ind	T.I. - B	7.4	2.01	1278	240	1518	185	760	400	20	7.6	26	0.4	256	280	3	2.86
3	Textile Ind	T.I. - C	7.41	1.94	1258.2	13.26	1271.46	319.5	650	610	29	16	70	2	280	260	6	0.5
4	Textile Ind	T.I. - D	7.28	1.46	980.2	1.6	981.8	297.5	200	480	10	20	210	0.8	316	170.5	1	Negligible
5	Pharmaceuticals	Ph. I - A	7.76	2.31	1472.6	19.62	1492.22	366.25	950	795	26	2.6	50	1.6	610	126	1	2.06
6	Pharmaceuticals	Ph. I - B	7.4	1.42	930.26	860.6	1790.86	866.25	320	215	5	0.8	70	1.4	280	210.6	3	0.27
7	Pharmaceuticals	Ph. I - C	8.58	1.66	1084	73.88	1157.88	330.75	680	310	4	2.36	56	1.8	296	190	8	1.98
8	Pharmaceuticals	Ph. I - D	7.36	2.25	1475	3.2	1478.2	266.25	1050	425	14	8.6	71.63	3.2	160	280.6	8	2.76
9	Printing	P.I. - A	7.33	1.14	740.26	810	1550.26	324.25	610	250	26	3	170.62	1.6	580	340.6	16	0.59
10	Printing	P.I. - B	8.01	1.4	886	13.6	899.6	250	750	245	14	2.68	38.22	0.4	110	200.6	10	0.8
11	Printing	P.I. - C	8.03	1.51	990	312	1302	305.5	580	260	12	0.8	68	0.8	280	260.8	12	1.4
12	Printing	P.I. - D	8.21	1.58	1030.42	408	1438.42	356	580	230	18	3.6	130.2	1.6	270	280	14	1.2
13	Food Products	F.P. - A	7.27	2.05	1332	26.1	1358.1	301.75	930	410	20	6.45	120	0.8	110	380	16.5	1.7
14	Food Products	F.P. - B	7.23	2.82	1824.8	178	2002.8	360.6	1560	660	55	4.05	126	2.8	710	420	16	2
15	Food Products	F.P. - C	6.3	3.3	2142	230	2372	905.5	1120	680	20	4.05	126	2.8	610	350	16.5	2.4
16	Food Products	F.P. - D	7.35	2.5	1630	160.8	1790.8	790	1260	430	32	1	140	2.6	510	210	14	2.08
17	Mixed effluent	M.E. - A	7.74	1	680	1.6	681.6	120.26	310	300	16	6.08	60	4.8	516	220	7.8	1
18	Mixed effluent	M.E. - B	7.35	1.38	896.4	74	970.4	180.8	680	200	26	2.4	34.25	2.8	580	390	9	0.84
19	Mixed effluent	M.E. - C	7.82	2.5	1620	2.2	1622.2	276.8	1080	720	28	2.6	60	3.8	596	240	28	2.6

Table 4: Result of analysis of underground water during monsoon season 2007

S. No.	Site	Sample No.	pH	Ec	TDS	TSS	Total solids	Chloride	Sulfate	Hardness	P	Fluoride			
			mmh o/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			
1	Bore well water	B.W-A	7.58	1.141	720.24	720.24	213.42	870	147	4	5.6	37.4	5.8	130	0.28
2	Open well water	O.W-A	8.32	1.28	806	806	210.16	770	140	2.62	3	37.8	9.8	120	Negligible
3	Bore well water	B.W-B	7.61	3.3	2130	2130	960.9	500	886	9.02	36	362	6	280	0.5
4	Bore well water	B.W-C	7.63	2.94	1860.6	1860.6	710.52	790	580	8.04	25.41	188.4	6	285	Negligible
5	Bore well water	B.W-D	8.42	1.522	980.4	980.4	106.5	700	520	2	5.8	26	3.6	180	2.14
6	Bore well water	B.W-E	7.22	1.5	910	910	280.96	630	450	4	5.07	56	2.6	230	0.38
7	Hand pump water	H.P-A	7.55	2.88	1820	1820	448.92	910	680	7.82	9	94.4	3.8	310	2
8	Hand pump water	H.P-B	7.76	1.82	1150.2	1150.2	210.92	700	410	2	2.8	26.4	6.4	190	1
9	Hand pump water	H.P-C	7.56	3.1	2030.6	2030.6	914.46	700	748	2.45	9.8	250.08	7.4	405	1.5
10	Open well water	O.W-B	9.52	2.16	1320.4	1320.4	228.12	790	680	40.62	6.02	174	3.8	128	3.5
11	Open well water	O.W-C	7.48	1.12	720	720	210.12	350	68	2.02	6.6	112.6	6.8	355	Negligible
12	Open well water	O.W-D	7.27	1.34	856.2	856.2	166.62	540	250	0.62	7.42	30.6	6.2	160	Negligible
13	Open well water	O.W-E	7.48	1.08	658.4	658.4	112.92	300	230	1.58	9.44	21.68	8.4	218	Negligible
14	Open well water	O.W-F	7.16	1.19	760.6	760.6	180.96	190	132	2.44	14.4	36.78	9	310	Negligible

Chloride

Chloride values varied from 106.5 to 960.9 mg/L. The Chloride of few samples are above the desirable limit but below the permissible limit as per Indian Standard. Chloride is one of the important parameters to know the quality of water. High chloride causes cardiovascular problems, gives a bitter taste to water, corrodes steel and affects the solidity and strength of concret¹³.

Total Alkalinity

Total alkalinity of few samples are above permissible limit.

Sodium and Potassium

The values of sodium and potassium were in the range of 68-886 ppm and 0.62 -40.62 ppm. The value of sodium of mostly all samples above WHO guideline i.e. 200 mg/L except few samples.

Nitrate

The nitrate values were found from 2.8 to 36 mg/L. The nitrate values are under desirable limit as per Indian standard i.e. 45 mg/L.

Sulphate

The sulphate values varied between 21.68 to 362 mg/L. The value of sulphate of all samples under permissible limit as per Indian Standard and WHO i.e. M400 mg/L.

Dissolved Oxygen

Its values were noted from 2.6 to 9.8 mg/L. Do as a parameter is very useful for assessing the quality of water and providing a check on pollution¹⁰.

Hardness

Hardness found to be from 120 to 405 mg/L. The hardness of water samples are under

permissible limit as per IS and WHO guideline. Hardness may be due to the ground water receiving calcium and magnesium rich minerals leached from rocks and other deposits like limestone, gypsum and clay minerals. Sewage and domestic wastes are also important sources of total hardness in ground water¹⁴.

Phosphorus

The values of phosphorus varied between negligible to 3.5 mg/L.

Fluoride

The values of fluoride were noted from 0.12 to 2.42 mg/L. The value of fluoride of some water samples are above the permissible limit as per BIS & WHO guideline.

CONCLUSION

The industrial effluents data indicate, that the pH and TDS are under permitted limit but TSS and COD of few effluent samples are at higher side in the industrial effluents. Effluents should not be discharged into nearby water bodies or in soil without treatment. The results of underground water indicate, that the value of some parameters of few samples are at higher side, which may be due to seepage of effluent. So the underground water of SIA should be used for drinking purpose after treatment.

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