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IMPACT OF DOMESTIC AND INDUSTRIAL EFFLUENT ON WATER AND SOIL QUALITY OF SANGANER OF "HERITAGE CITY", JAIPUR

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ABSTRACT

The study aims to analyse the impact of domestic and industrial waste effluents on water and soil quality of Sanganer, Jaipur. For the collection of samples of water, three and for the samples of soil, four stations were identified along the Sanganer nallaha where the effluents fall in the nallaha. Also ten spots of tube wells and open wells were selected for water sampling. Water pollution levels at various spots in Sanganer were monitored and compared with that of standards. The analysis reveals that the water at most of all the places is slightly hard, contaminated, and hence unsuitable for drinking purpose. Untreated water coming from painting, printing and textile industries has caused water pollution. The remedies suggested are to prevent mixing of untreated sewage into the nallaha, to set up water testing laboratory at water treatment plant and create an awareness among the people through arranging various programmes and demonstrations.

Key words : Industrial effluent, Domestic waste, Soil and Groundwater.

INTRODUCTION

Now–a–day man is facing one of the most severe ecological crises of pollution of environment as well as of water. Water pollution is a phenomenon that is characterized by the deterioration of the quality of water as a result of various human activities. In fact for centuries, rivers and lakes have been used as dumping grounds for human sewage and industrial wastes of every conceivable kind, many of them have been highly toxic. Added to this have been the materials leached and transported from land by water percolating through the soil and running on its surface to aquatic ecosystems. In the era of urbanization and industrialization, the problem of water pollution is emerging very fast. Keeping these facts in view, an effort has been made to assess the impact of industrial and domestic waste effluents on water and soil quality of Sanganer of "Heritage city", Jaipur.

EXPERIMENTAL

The water samples were collected from different stations. A total fourteen sampling points were selected for the study, these were selected on the basis of their importance. The samples were collected during the month of October 2002. Samples for analysis were collected in sterilized bottles using the standard procedure for grab or catch samples in accordance with the standard methods[1,2]. The instruments were used in the limit of précised accuracy and chemicals used were of analytical grade. The parameters and methods selected for the said examination are detailed in Table 1.

Soil samples were collected by post hole auger as per standard procedure recommended by United States Department of Agriculture (USDA), carefully from four different points in the month of October, 2002. Samples were collected from the depth of 0 ft, 1 ft, 2 ft, 3 ft, 4 ft and 5 ft at a distance of 5 kms. and preserved in polythene bags for analysis.

Table 1. Parameters and methods employed in the chemical examination of sample

S. No.	Parameters of Water Analysis	Method
1.	Temperature	Thermometric
2.	pH	Potentiometric
3.	DO	Azide modification
4.	BOD	Azide modification
5.	COD	Dichromate reflux
6.	Chloride	Argentometric
7.	TDS	Gravimetric
8.	Calcium	Titrimetirc
9.	Magnesium	Titrimetric
10.	Nitrate	Spectrophotometric
11.	Phosphate	Spectrophotometric
12.	Sulphate	Spectrophotometric

The soil samples were first dried in sunshine by spreading on a wooden plant and then crushed with the help of a wooden pestle in a wooden mortar. The ground mass, passing through 2 mm ASTM seive, mixed thoroughly and stored in a suitable sample bottle. Physico–chemical parameters of soil samples have been determined by standard methods[3]

RESULTS AND DISCUSSION

The chemical examination of water samples was carried out for the temperature, pH, BOD, COD, chloride, TDS, calcium, magnesium, nitrate, phosphate, sulphate and fluoride. The analytical results of various tube well's, open well's and nallaha's have been shown in Table–2.

Table 2. Physico – chemical parameters of effluent and underground water in Sanganer town of Jaipur City after monsoon, 2002–2003

S. No.	Parameters	Sanganer Nallalha Near Bridge	T/W Mohammad Bhai	Effluent Nallaha Near Gular Dam	Saini Farm	Effluent Nallaha Near Bambala Bridge	O/W Kotawala	T/W Pipaliwala	T/W JIILM	O/W Ramkishore Dehlawas	T/W Harinarayan Dehlawas	T/W Sogani Garments	O/W Sogani Garments	T/W S.W.H. Goner Road	O/W Haldiya Farm
1	Temp. (^{0}C)	27.6	27.6	27.6	28	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
2	pH	7.6	8.2	8.6	8.1	8	8.3	8.8	8.8	8.9	8.6	8.3	8.2	8.3	8.3
3	Total Alkalinity (mg/L)	440	460	630	580	580	570	600	370	570	440	380	460	510	510
4	Total Hardness (mg/L)	520	460	440	420	480	360	160	420	240	510	290	480	220	340
5	Calcium Hardness (mg/L)	280	310	240	240	280	180	70	150	160	170	90	110	160	210
6	Magnesium Hardness (mg/L)	240	150	200	180	200	180	90	270	80	340	200	440	60	130
7	Carbonate Hardness (mg/L)	440	460	440	420	480	570	160	370	240	440	290	180	220	340
8	Non–Carbonate Hardness (mg/L)	80	Nil	Nil	Nil	Nil	Nil	Nil	50	Nil	70	Nil	Nil	Nil	Nil
9	Chloride (mg/L)	290	260	280	280	260	220	90	90	160	360	220	180	220	250
10	Sulphate (mg/L)	310	268	66	66	102	120	40	268	128	154	4	100	120	116
11	Nitrate (mg/L)	30	22	20	20	16	24	18	38	10	22	32	20	14	12
12	Total Dissolved Solid (mg/L)	1480	1120	1200	1200	1280	1040	960	1040	1040	1440	960	1180	960	1040
13	Fluoride (mg/L)	0.8	0.8	0.3	0.3	1.5	0.4	1.5	0.6	2.2	1.8	1.4	0.9	1	1.1
14	B.O.D. (mg/L)	180	Nil	74	Nil	74	Nil	3.2	Nil	Nil	Nil	Nil	Nil	Nil	Nil
15	C.O.D. (mg/L)	440	Nil	85	Nil	90	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Temperature of water sample is 27.6°C. The various chemical and biological reactions in water depend to a great extent on the temperature. The variation of water temperature was directly related to atmospheric temperature having more effect directly or indirectly on all life processes. A pH range of 6.5 to 8.5 is normally accepted as per guide line suggested by WHO. The pH value of water sample in the study area ranged from 7.6 to 8.9. This shows that the pH of water sample was observed to be slightly alkaline. It is known that pH of water does not cause any severe health hazard. The alkaline pH is a usual feature of productive water bodies.

Desirable limit of total dissolved solid is 500 mg/L. All the values obtained are much higher than the limits. TDS is an important parameter for drinking water and such water should be used for other purpose. Beyond certain limit, it imparts a peculiar taste to water and reduce its pot ability.

The chloride content of water samples except some points are within the limit. It is varied from 90 mg/L to 360 mg/L. The values show that the chloride contents of samples were not high. These amounts will not impart any taste to water. The amounts present do not exceed the maximum permissible limit i.e., 500 mg/L for drinking water. The chloride is troublesome in irrigation water and harmful for aquatic life.

Presence of sulphate has less effect on the taste of water compared to the presence of chloride. High value of sulphate above 500 mg/L produces bitter taste to water and exerts adverse effect on human[4]. The desirable limit of sulphate in drinking water prescribed by ICMR is 200–400 mg/L. All the water samples collected from the Sanganer have satisfied the drinking water quality so far presence of sulphate is concerned.

There have been changes in the fluoride concentration also. For drinking water, the maximum permissible limit for fluoride is 1.5 mg/L. If concentration of fluoride exceeds 2 mg/L and water is used continuously for drinking over years, it causes fluorosis with resultant skeletal damage in man and cattle. However, presence of less than 0.8 mg/L fluoride in water causes dental carries in children .The values of fluoride in water samples were varied from 0.3 mg/L to 2.2 mg/L.

Nitrate in water supplies in concentration over 100 mg/L causes methamoglobinamia, particularly in infants up to six months of age, whose main liquid intake is powdered milk formula made up with tap water containing high concentration of nitrates. Nitrate forms nitrosoamines in stomach which causes gastric cancer[5]. In all the samples tested, nitrate was within the limit for general use.

The desirable limit for hardness in drinking water according to IS–10500 is 300mg/L. Total hardness at all stations except some points was found to be much higher than the said limit. Water of these sources is not suitable for drinking and laundry work. Its values varied for water samples from 160 mg/L to 520 mg/L.

The desirable limit for total alkalinity is 200 mg/L. The value of water samples were varied from 370 mg/L to 630 mg/L. In water, it is useful as it provides buffering to resist changes in the BOD of water sample. The presence of higher BOD indicates entry of organic waste in the water. It is an indication of the alarming conditions and hence treatment is needed before the use of water for various purposes. The BOD level of water samples varies from 3.2 mg/L to 180 mg/L.

The maximum permissible value of COD is 10 mg/L for drinking water. The values of all the water samples except some points was nil. COD test is extensively used for analysis of industrial wastes and helpful in indicating organic matters[6]

The physical and chemical properties of four experimental soil samples, six from each location at different depths, are represented in the Tables–3 to 6. pH of the soil is the measure of the hydrogen ion acitivity and depends largely on the relative amounts of the adsorbed hydrogen and metallic ions. Thus, it is a good measure of acidity and alkalinity of soil–water suspension and provides a good identification of soil's chemical nature. All soil samples were alkaline in nature. Generally observed pH in the surface soil at 0 ft varied from 7.7 to 8.0, at 1ft varied from 7.4 to 8.0, at 2 ft from 7.5 to 8.0, at 3 ft varied from 7.4 to 8.0, at 4 ft 7.3 to 8.0 and at 5 ft varied from 7.3 to 8.0.

Table 3. Physico–chemical parameters of soil in Sanganer town in Jaipur City near Sanganer bridge after monsoon, 2002

S. No.	Parameters	Near Sanganer bridge					
		0A	1A	2A	3A	4A	5A
1	pH	8.5	8.6	8.5	8.6	8.6	8.6
2	Total Alkalinity	200	240	200	280	300	200
3	Total Hardness	100	100	100	80	120	100
4	Calcium Hardness	50	50	50	30	60	50
5	Magnesium Hardness	50	50	50	50	60	50
6	Carbonate Hardness	100	100	100	80	120	100
7	Chloride	260	140	140	140	140	120
8	Sulphate	120	76	120	56	64	64
9	Nitrate	90	72	78	60	100	146
10	Fluoride	0.7	0.7	0.7	0.6	0.7	0.6
11	Electrical conductivity	1040	800	800	800	880	720

All the values are in mg/L except pH and electrical conductivity. Electrical conductivity is in mho/L.
0A– 0 ft, 1A – 1 ft, 2A – 2 ft, 3A – 3 ft, 4A – 4 ft, 5A – 5 ft

Table 4. Physico–chemical parameters of soil in Sanganer town in Jaipur City near Harinarayan mali ka khet after monsoon, 2002

S. No.	Parameters	Near Hari Narayan mali ka khet					
		0A	1A	2A	3A	4A	5A
1	pH	7.8	7.7	7.8	7.6	7.6	7.6
2	Total Alkalinity	180	150	130	140	130	130
3	Total Hardness	80	40	40	40	30	30
4	Calcium Hardness	50	30	30	20	20	20
5	Magnesium Hardness	70	30	20	20	10	10
6	Carbonate Hardness	110	40	30	20	20	20
7	Non Carbonate Hardness	90	80	10	10	10	10
8	Chloride	40	40	30	30	30	20
9	Sulphate	34	24	18	8	8	8
10	Nitrate	180	38	28	16	16	16
11	Fluoride	1.0	1.0	0.6	0.6	0.4	0.4
12	Electrical conductivity	480	184	240	240	234	218

All the values are in mg/L except pH and electrical conductivity. Electrical conductivity is in mho/L.
0A– 0 ft, 1A – 1 ft, 2A – 2 ft, 3A – 3 ft, 4A – 4 ft, 5A – 5 ft

Table 5. Physico–chemical parameters of soil in Sanganer town in Jaipur City near Haldiya farm after monsoon, 2002

S. No.	Parameters	Near Haldiya Farm					
		0A	1A	2A	3A	4A	5A
1	pH	7.9	7.4	7.8	7.8	7.7	8.0
2	Total Alkalinity	160	90	150	120	120	150
3	Total Hardness	970	210	190	110	130	80
4	Calcium Hardness	490	100	90	60	70	30
5	Magnesium Hardness	480	110	100	50	60	50
6	Carbonate Hardness	160	90	150	110	120	80
7	Non Carbonate Hardness	810	120	40	Nil	10	Nil
8	Chloride	760	190	260	40	30	40
9	Sulphate	1220	92	44	64	70	54
10	Nitrate	101	71	19	24	26	29
11	Fluoride	0.4	0.3	0.4	0.9	0.9	1.4
12	Electrical conductivity	1800	720	880	448	400	368

All the values are in mg/L except pH and electrical conductivity. Electrical conductivity is in mho/L.
0A– 0 ft, 1A – 1 ft, 2A – 2 ft, 3A – 3 ft, 4A – 4 ft, 5A – 5 ft

Table 6. Physico–chemical parameters of soil in Sanganer town in Jaipur City Shri Narayan Sharma ka khet after monsoon, 2002

S. No.	Parameters	Shri Narayan Mali ka khet					
		0A	1A	2A	3A	4A	5A
1	pH	7.7	7.6	7.5	7.4	7.6	7.3
2	Total Alkalinity	150	70	90	100	90	60
3	Total Hardness	1230	950	490	500	590	440
4	Calcium Hardness	620	500	250	270	290	230
5	Magnesium Hardness	610	450	240	230	300	210
6	Carbonate Hardness	150	70	90	100	90	60
7	Non Carbonate Hardness	1080	880	400	400	500	380
8	Chloride	270	30	50	60	60	80
9	Sulphate	288	624	336	380	408	340
10	Nitrate	1060	48	42	9	45	19
11	Fluoride	0.4	0.3	0.3	0.2	0.2	0.2
12	Electrical conductivity	1840	1120	800	960	960	880

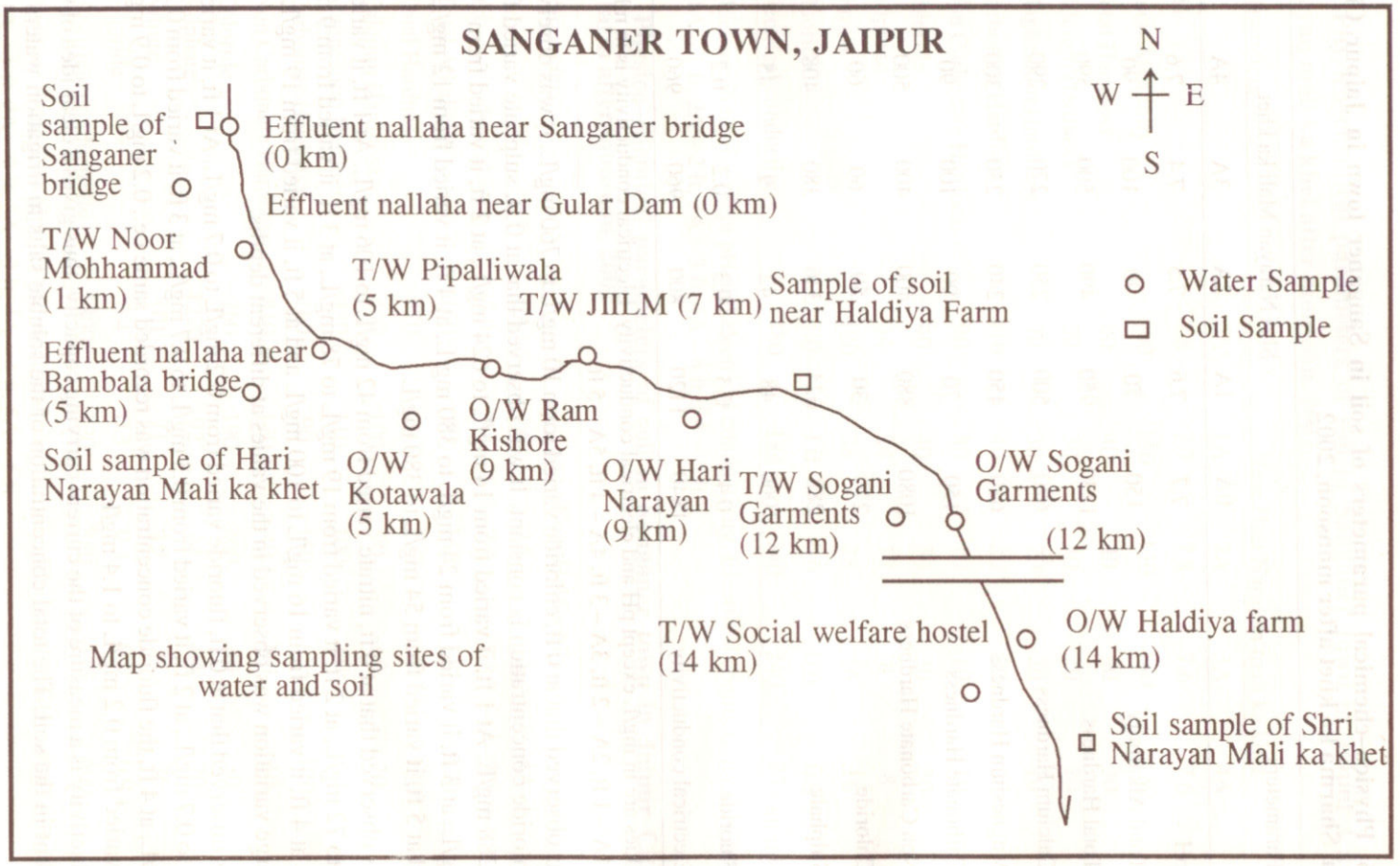
All the values are in mg/L except pH and electrical conductivity. Electrical conductivity is in mho/L. 0A– 0 ft, 1A – 1 ft, 2A – 2 ft, 3A – 3 ft, 4A – 4 ft, 5A – 5 ft

It was observed that at 0 ft, chloride varied form 10 mg/L to 760 mg/L. It was observed that at 0 ft, chloride concentration is constant. It was observed that at 0 ft, sulphate varied from 10 mg/L to 288 mg/L. At 1 ft, it varied from 14 mg/L to 624 mg/L, at 2 ft, it varied from 10 mg/L to 366 mg/L, at 3 ft, it varied from 24 mg/L to 380 mg/L, at 4 ft, it varied from 12 mg/L to 408 mg/L and at 5 ft, it varied from 54 mg/L to 380 mg/L.

It was observed that at 0 ft, nitrate varied from 42 mg/L to 106 mg/L. At 1 ft, it varied from 36 mg/L to 72 mg/L, at 2 ft, it varied from 19 mg/L to 78 mg/L, at 3 ft, it varied from 9 mg/L to 60 mg/L, at 4 ft, it varied from 16 mg/L to 100 mg/L and at 5 ft, it varied from 19 mg/L to 146 mg/L. Large variation was observed in the values at different depths.

It was observed that at 0 ft, fluoride varied from 0.2 mg/L to 0.7 mg/L. At 1 ft, it varied from 0.3 mg/L to 0.7 mg/L, at 2 ft, it varied from 0.3 mg/L to 0.7 mg/L, at 3 ft, it varied from 0.2 mg/L to 0.9 mg/L, at 4 ft, the fluoride concentration was recorded same i.e., 0.2 mg/L to 0.9 mg/L and at 5 ft, it varied from 0.2 mg/L to 1.4 mg/L.

Conductivity is a measure of the current carrying capacity, thus gives a clear idea of soluble salts present in the soil. The total concentration of the soluble salts in irrigation waters can be



Map showing sampling sites of water and soil

adequately expressed for the purposes of diagnosis and classification in terms of electrical conductivity. The values below 750 micromhos/cm are satisfactory for irrigation. High conductivity was found in polluted soils. As pollution levels increases, there is an increase in the conductivity. It was observed that at 0 ft, the conductivity varied from 200 micromhos/cm to 1840 micromhos/cm. At 1 ft, it varied from 192 micromhos/cm to 1120 micromhos/cm, at 2 ft, it varied from 168 micromhos/cm to 880 micromhos/cm, at 3 ft, it varied from 200 micromhos/cm to 960 micromhos/cm, at 4 ft, it varied from 176 to 960 micromhos/cm and at 5 ft, it varied from 288 micromhos/cm to 880 micromhos/cm.

The foregoing analysis reveals that increased urbanization and industrialization have resulted in deterioration of water quality. The nallaha water is having blackish–greenish tinge, bad odour and unpleasant taste. Therefore, it cannot be used for drinking purpose without any treatment. To get potable water, the recommendations made need to be implemented immediately. It can be concluded that the Sanganer area is polluted in terms of water and soil pollution. The various parameters signifies that an immediate attention should be given in order to prevent pollution and parameter in their desirable limits. The major cause of pollution is due to cluster of small scale industries in the area of Sanganer whereas sewage disposal is another major source in nearby areas of Sanganer. Therefore, immediate care should be taken in order to reduce pollution load, which is likely to exceed abnormously in near future. It can be said that the water treatment procedures currently adopted by the industries are insufficient as compared to their wastes generated. It is proposed that there should be an inbuilt effluent treatment plant for each industry and there should be a common treatment plant also for the common effluents.

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